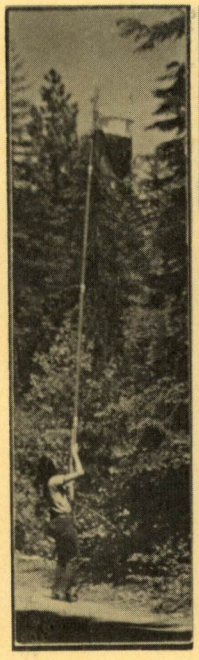
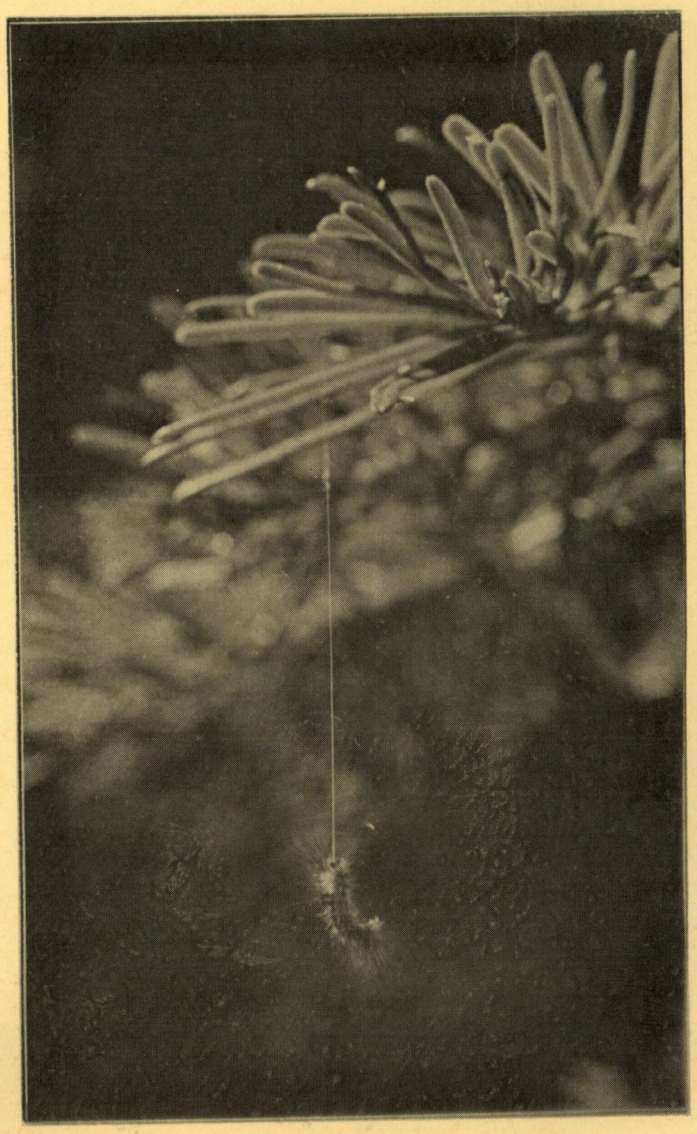
1974



NORTH IDAHO COOPERATIVE DOUGLAS-FIR TUSSOCK MOTH CONTROL PROJECT

REPORT



1974
NORTH IDAHO COOPERATIVE DOUGLAS-FIR TUSSOCK MOTH CONTROL PROJECT

REPORT

State of Idaho
Department of Lands

U. S. Forest Service
Northern Region

Forest Industry

Bureau of Indian Affairs
Coeur d'Alene Tribe

by

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State of Idaho
Department of Lands
Division of Forest Management
Coeur d'Alene, Idaho

Report No. 75-1
February 1975

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* Philip Schofield
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INTRODUCTION AND SUMMARY

This report summarizes the results of a 1974 forest protection project using DDT for control of the Douglas-fir tussock moth.

The tussock moth is an important defoliator of true firs, *Abies* spp. L., and Douglas-fir, *Pseudotsuga menziesii* var. *glauca* (Beissner) Franco, over much of western North America. In Idaho, the favored hosts are Douglas-fir and grand fir, *Abies grandis* (Dougl.) Lindl. However, if preferred food is scarce, the tussock moth will feed on many coniferous species.

Damage to trees is caused by the newly hatched larvae feeding on new foliage causing it to shrivel and turn brown. By mid-July, larger larvae feed on both new and old foliage, first stripping the tops of trees and outermost portions of branches, then feeding into the inner crown (Mason and Baxter, 1970; Wickman, et al., 1971). While many trees are only top killed, occasionally they are completely defoliated and killed in one season (Tunnock, 1964). Trees weakened through defoliation are reported to suffer pronounced growth loss, and many have been subsequently attacked by bark beetles (Wickman, 1963). Outbreaks of the Douglas-fir tussock moth, *Orgyia pseudotsugata* McD., have occurred in northern Idaho on a cyclic basis. History of these outbreaks has been reviewed by Tunnock (1973).

Indications that an outbreak was again building up in North Idaho were discovered in Coeur d'Alene, Idaho, during 1971 when several ornamental firs were defoliated (Tunnock and Honing, 1971) and in 1972 when egg masses were found within a 100-acre logging unit near Charles Butte, St. Joe National Forest, Idaho (Tunnock, 1972). Concurrent outbreaks were also developing in Oregon and Washington (USDA Environmental Statement, March 1974). A February 1973 egg mass survey, conducted in areas of previous outbreaks, substantiated the buildup and predicted a minimum of 50,000 acres of visible defoliation in the survey area (Livingston and Tunnock, 1973). Aerial surveys completed during the summer of 1973 showed nearly 100,000 acres with varying degrees of visible defoliation (Tunnock, et al., 1973).

To predict what this outbreak would do in 1974, a broad-scale egg mass survey was conducted during October and November, 1973. As part of the survey, supplemental collections of egg masses were made to assess the impact of egg viability, egg parasitism, and virus on defoliation potential and to readjust proposed treatment boundaries accordingly. We found 103,878 acres of forest in North Idaho with overwintering tussock moth populations capable of causing damage in 1974 (Tunnock, et al., 1974). Of these a critical 57,608 acres were to be sprayed with DDT. A spring 1974 survey of additional areas known to harbor the tussock moth added another 34,200 acres to the proposed treatment area (Ludeman and Livingston, 1974). Further adjustments made during the project brought the final total acreage sprayed to 75,254 acres. The remainder were set aside for testing of microbial agents. Similar work in Oregon and Washington resulted in the spraying of approximately 350,205 acres.

The North Idaho fall egg mass survey was the cooperative effort of a special task force established by the Northern Rockies Forest Pest Action Council.

Participants included the State of Idaho Department of Lands, U. S. Forest Service Region I, Potlatch Corporation, Bureau of Indian Affairs, Corps of Engineers and the University of Idaho. These same agencies, exclusive of the Corps of Engineers and the University, provided the majority of the manpower needed for the DDT spray project. Further cooperation was achieved through the establishment (in 1973) of a Douglas-fir Tussock Moth Interagency Steering Committee with representation from the Idaho Department of Lands, Oregon Department of Forestry, Washington State Department of Natural Resources, Forest Service (administrative and research), Bureau of Indian Affairs, Bureau of Land Management, Oregon State University and the Federal Environmental Protection Agency (EPA). This group served to coordinate all phases of the tussock moth control program in the three state areas.

Due to the large forested area affected, and the need to apply chemicals over this area, a National Environmental Policy Act Environmental Statement was prepared after the fall 1973 survey with input from all of the above named agencies. This was filed in draft form with the Council on Environmental Quality on December 28, 1973 and in final form on March 29, 1974. Using the impact statement as a supporting document the U. S. Department of Agriculture requested, on January 3, 1974, an exemption from provisions of the Federal Insecticide, Fungicide, and Rodenticide Act prohibiting use of DDT, to allow its emergency use, if needed, to control the tussock moth during 1974. This request was granted by EPA on February 28, 1974 (Federal Register, Vol. 39, No. 44, 1974).

The 1974 North Idaho spray project was concentrated in the mountainous areas between Moscow and St. Maries, Idaho. This is basically the same area that was treated with DDT for control of the Douglas-fir tussock moth in 1947 and 1965 (Evenden and Jost, 1947; Scribner, 1965). Final treatment boundaries for the 1974 project were established on the basis of predicting 20 larvae per 1,000 square inches of foliage. This population level is the threshold for causing visable defoliation and was set as the level constituting an emergency condition as outlined by the EPA (Tunnock and Livingston, 1974; Federal Register, Vol. 39, No. 44, 1974).

The 56 persons staffing the project assembled at Potlatch, Idaho, project headquarters, on May 28, 1974. Spraying began on June 19 and was completed on July 8, with a total of 75,254 acres treated. Spraying was by helicopter at the rate of 3/4 lb. of DDT per acre, a rate that has been used against the Douglas-fir tussock moth since 1964 (USDA Environmental Statement, 1974). The resulting tussock moth larval mortality was excellent, averaging 97.77% corrected mortality four days after spraying and 99.8% corrected mortality 21 days after spraying. Foliage protection evaluations showed that a significant amount of foliage was saved by the spray when compared to non-sprayed areas. This in turn will help prevent weakening of the trees, possible subsequent attack by bark beetles, growth reduction and top kill.

Project costs on a per acre basis were $2.13 for spraying, $1.05 for pesticide, $0.47 for observation and utility aircraft, and $2.14 for administration, travel, per diem and miscellaneous services and equipment. Total cost, excluding monitoring, was $435,675.07 or $5.79 per acre. Pesticide residue monitoring costs have been estimated at $0.90 per acre. Final figures will not be available until the summer of 1975 when sample analysis will be completed.

PROJECT OPERATIONS

Staff Operations

Administration

Assistant Land Commissioner Jack Gillette and William Ciesla, U. S. Forest Service, Region I, started the project. They agreed early in February that Dewey Almas, Branch Chief-Private Forestry, Idaho Department of Lands and Wayne Bousfield, Entomologist, U. S. Forest Service, Region I, would be Project Director and Assistant Project Director respectively. Dr. R. L. Livingston, Entomologist, Idaho Department of Lands, was chosen as Project Entomologist. The State was assigned lead position because the forests in the spray units were predominantly State and private lands (Table 1).

TABLE 1

ACREAGE TREATED WITH DDT
BY OWNERSHIP

National Forest	17,200
Coeur d'Alene Indian Tribe	3,088
Private	47,366
State of Idaho	7,600
North Idaho Total	75,254

The three man core staff began writing a project plan, preparing organization charts and staff meetings. They met in Boise to coordinate with the South Idaho project on February 5, developing the project plan in Coeur d'Alene on February 15 and in Missoula on February 28 - March 1. It was decided that the State would furnish administrative, security, and information-education staff as well as all crewmen for weather, entomology and some air operations personnel. The Forest Service would provide staff for safety, monitoring liaison, air operations, communications, meteorology, heliport crews and a field laboratory assistant. These persons were to come from three sources: Region I Missoula, Clearwater National Forest and detailers from outside the region. Provisions were also made to include Bureau of Indian Affairs, Coeur d'Alene Tribe and forest industry personnel.

On March 25, Asst. Land Commissioner Gillette met in Coeur d'Alene with State project personnel to finalize procedures for spending State funds, acquiring vehicles and equipment, and obtaining additional personnel. A $404,000 appropriation was assured by the 1974 Session of the State Legislature upon recommendation of the State Land Board. This amount was to cover the entire project cost with subsequent matching funds by the U. S. Forest Service to reimburse the State for their share of the project cost. The State started accruing project costs on February 15.

On April 19 the Administrative Officer position was filled by retired Land Department employee Wilbur Atwood. He was directed to immediately begin acquiring lab equipment, vehicles, heliport equipment, weather monitoring instruments, office supplies and Moscow lodging for about thirty-five State personnel. The Project Director furnished him with a bookkeeping format which would also serve as an inventory.

The Administrative Officer coordinated all action with the U. S. Forest Service office in Missoula, the Clearwater National Forest and the Palouse Ranger District. The Palouse Ranger District assisted in acquiring office equipment, fuel tanks, a field headquarters and State crewmen to be recruited locally.

According to the organization plan the Director would coordinate and supervise five staff officers. The Assistant Project Director supervised five persons of the line organization. The plan of operations organization chart (Appendix No.1) shows a graphic presentation of authority for the project.

The field headquarters was placed at the Potlatch High School vocational building. The Palouse Ranger District permitted temporary use of the district bunkhouse from May 20 until high school vacation on June 1. The two large rooms of the vocational building filled the need for office and work space. Eleven borrowed desks and several work benches of the vocational building were used (Figure 1).

Figure 1.--Office area in Potlatch High School Vocational Arts Building.

The project plan called for 56 personnel directly involved in the control operation. This manning level was in anticipation of operating three spray heliports simultaneously. All personnel involved in the pesticide monitoring effort provided their own quarters and office facilities. The monitoring liaison did, however, provide an area for supply pick-up and sample storage. All project spraying and sampling schedules, operations maps and aerial photos were on display at specified tables or display boards in the headquarters, and available to monitoring units and the public to examine or copy.

Information and Education

By mid-April the Information Program was on a full time basis. Rex Johnson, veteran I & E officer for the 1965 project, filled the I & E position. He started by studying public hearings records, DDT controversy literature and the draft project plan. He went to Missoula to confer with Regional Forest Service I & E experts. This visit culminated in the printing of some 2,000 one page "Northern Idaho Douglas-fir Tussock Moth Control Project" fact sheets.

The information in the fact sheet was included in "Woodland Notes", a newsletter published by Area Extension Forester Don White. It was mailed to 3,500 private forest owners in the four northernmost counties of Idaho about May 1. The article included schedules of forthcoming community meetings, locations of posted spray area maps and phone number of control project headquarters.

About May 1 the information detailed above was sent to the 450 forest owners determined to own lands inside or within one mile of the proposed spray blocks. This two page letter also explained the extent of the infestation, costs to landowners, purposes of the forthcoming community meetings, the risk of DDT residues in livestock grazed in sprayed areas, and solicited requests for forest inspection for tussock moth. Attached to the letter was a schedule of meetings, posted map locations and the fact sheet. Extra copies were sent to involved agencies (Appendix No. 2, five page packet to forest landowners).

Nine community meetings were scheduled between May 3 and May 31. Prior to each meeting extension agents notified local newspaper and radio stations of the meeting. These notices were printed and broadcast locally. Forest Service and extension personnel posted schedules and publicized the meetings. The meetings lasted for about two hours starting at 7:30 P. M. At the end of the meetings all questions were answered. The names and addresses of those wanting inclusions, exclusions or more information were recorded for follow-up contact (Appendix No. 3, Community Meeting Outline).

A local Forest Service representative and the extension agent attended each meeting. At most meetings the Forest Service placed an attractive display illustrating tussock moth life cycle. Two of the community meetings were coordinated with other units; in Lewiston with the Pomeroy unit and in Coeur d'Alene with the microbial test project.

Public notices of spray areas (Appendix No. 4) were placed in post offices,

general stores, agency offices and courthouses. These notices consisted of an area map, dates of operations, phone numbers, and addresses of the St. Joe and Pomeroy Units. The poster solicited inquiries for more information. The I & E Officer and the two State woodland foresters personally contacted every resident landowner requesting additional information or having concern about exclusions or sensitive areas. One of the maps displayed in the headquarters showed all sensitive areas, exclusions and buffered areas marked on it. The information was coordinated and transmitted daily between the I & E Officer, the Asst. Project Director, the Air Operations and Entomology Chiefs.

News and Tours

Beginning with the April 18 project staff meeting, formal news releases were prepared reporting the stages of project preparation. These were mailed to all local papers including one in Spokane, Lewiston and Coeur d' Alene. Only mild interest was shown in these releases. Reporters were extremely anxious to announce the date of spraying and called frequently for this information. After spraying started the Lewiston Tribune called daily for a report and the national wire services called occasionally.

During the operations the I & E Officer prepared releases highlighting various aspects of the project including the monitoring program. Legislative liaison Royce Cox assisted in news dissemination towards the end of operations.

The Northern Rockies Pest Council sponsored a tour during spraying on June 24-25. An evening meeting on the 24th served as a briefing and the following morning at 5:00 A. M. a school bus left headquarters for Gold Hill heliport to observe spraying and air operations. The tour guests were then taken to Jerome and Boulder Creeks. After spraying they saw live larvae in a streamside buffer strip and dead and dying larvae a few hundred yards up the ridge in the sprayed zone. They were shown how a foliage sample was collected. They observed a stream monitoring station where Al Espinosa and Woody Benson explained the monitoring program. The tour group then returned to the headquarters where various details, including the lab techniques, were explained. All questions were answered and discussed. Costs of the tour, including refreshments, were paid by the Pest Council.

About 98% of the forest landowners approved the project and wanted their lands sprayed. With one exception no complaints of misapplication or carelessness by spray project personnel were received from the local citizenry. A lady told a mid-July tent caterpillar evaluation crew that the helicopters sprayed the entire valley in which she resides. Her farm is two miles from the nearest spray block. No reports of harm to apiaries, water supplies, fisheries, wild or domestic animals or birds were received by the project staff. However, the residue monitoring group reported an increase of aquatic insect drift in a sample stream.

Adverse public sentiment was manifested by three forest settlements and by three small woods crews. The people were contacted and the project was explained to them. One settlement was outside the project area and two were excluded and buffered. The woods crews were alarmed because of uninformed evacuation requirements relayed to them by non-project agency personnel.

Visits by officials of the USDA and EPA were accommodated. EPA officials visiting the project included Deputy Assistant Administrator Henry Korp, Gordon Jones, Roger Pierpont, Douglas Hansen, Lynn Frandsen, Bob Poss and Don Donaldson. Korp, Jones, Pierpont and Hansen were provided ground and helicopter tours of the area. Deputy Assistant Secretary of Agriculture Robert Long, Regional Forester Steve Yurich, and Research Director Robert Buckman were also shown the project.

Safety

Don Jenni from the Clearwater National Forest worked as project safety officer. He was directed to implement all procedures necessary to minimize contamination and personal or property injury or damage in case of an accident. He was to take charge of these procedures until he could notify the director who would then take charge of accident investigation, care of injured or property damage.

The air operations chief was designated to conduct all safety procedures involving aircraft and heliport operations as well as aerial contractor activities.

Forest Service safety manuals were distributed to all supervisors and crew leaders after a safety training session prior to full scale operations.

No reportable injuries occurred on the project in the efforts of over 60 people including contractor crews. About 20,000 man hours were involved. The most common hazard, other than air operations, was the pre-daylight driving over the poor roads characteristic of private lands in mountainous terrain. About 38 vehicles were used by project and contractor personnel; a maximum of 5 aircraft were involved in 320 flights.

One off-duty traffic accident occurred when a local resident ran a stop sign in Moscow and damaged the side of the Entomology Chief's rented pickup while he was returning to quarters from an ice cream parlor.

Two minor incidents of pesticide misapplication occurred due to mechanical failures. On July 2, as a spray ship was returning to the heliport, a brace bolt sheared, causing the boom to break. The difficulty occurred after the spray tank was empty and an estimated three gallons of pesticide drained from the broken boom over a distance of about four miles. In another instance, the spray boom switch mechanism failed for 3-5 seconds when the spray ship was flying over a field on July 3. Approximately 1-2 gallons were sprayed during the switch failure.

It should be stated here that an upset of a USFS tanker truck loaded with 1,600 gallons of Sevin-4-oil pesticide formulation on the evening of July 8, about one-half mile east of Potlatch, was not connected to the DDT spray project or under supervision of the project director or air operations chief. This incident involved a special unit of Forest Service equipment and personnel brought to Potlatch to conduct a last minute Sevin-4-oil test. This hurriedly conceived project was initiated due to EPA and Forest Service concern over the cancellation of the Idaho virus and bacillus tests. The director agreed to assist the Sevin-4-oil test unit. They used some of the DDT

unit facilities, crewmen and pickups. The costs so incurred to the State were kept separate for full reimbursement.

Security

Starting with the inception of the project, the staff had some concern over security of the pesticide and aircraft as well as the more ordinary larceny and vandalism. Ultimately, the Latah County Sheriff Ed Pierson provided security without cost to the project. The Sheriff and Potlatch police provided drive-thru patrols of the vehicle parking area and visual checks of the DDT storage area.

The DDT formulation was stored in Harbor Distributing Co. tanks in the Potlatch yard of the Idaho Dept. of Highways. Project gasoline for state autos was stored in an oil company tank of 500 gallon capacity placed at the ranger station. The tank and gasoline were furnished with a locking valve meter. Forest Service and other vehicles refueled at local service stations. All personnel were continuously reminded of the responsibilities of security for the vehicles and for equipment.

Security of aircraft and pesticide in the aerial spray contractor's nurse trucks was the responsibility of the contractor. Heliport watchmen were not used although the contractor left the 205's and nurse trucks in the field most of the time. Aircraft fuel and service trucks were taken to quarters each night.

The only known loss of project property other than a few small tools was the disappearance of one 24-unit first aid kit. This item may have been unintentionally taken to the wrong agency during demobilization.

One incident of apparent displeasure towards the project occurred when the aerial observer saw what appeared to be an aerial flare, fired from the forest below, pass behind the spray helicopter. This incident took place while spraying block 25 adjacent to a woods settlement. This group had asked for and been given assurances that their property would be buffered and excluded, which was done.

Project Liaison and Support

Significant and vital assistance contributing to success of the project was given by several agencies and units not directly participating in the control operation.

Forest Service liaison and support from Supervisor Kenneth Norman, Clearwater National Forest, and staffmen including Tom Farbo and John Galea was predominant. Supervisor Ralph Kizer of the Panhandle Forest and Ranger Ed Kautz also assisted.

State coordination for monitoring was handled by Woody Benson of the Idaho Dept. of Environment and Community Services. Al Espinosa, Project Monitoring Liaison was named field coordinator for monitoring by Benson's office and was in charge to assure that all residue sampling was done.

A large contribution of time and effort was made by the Northern Rockies Forest Pest Action Council, most of the work done by Chairman Royce Cox and his staff. The council sent information letters to landowners, sponsored the news conference on March 29 and the information tour on June 25. The council paid the bill for the school bus and luncheon provided for the tour. Royce Cox also served as congressional liaison for the project.

Bureau of Indian Affairs contact was through James Ross of the Lapwai office.

Field Operations

Pesticide Handling

The State of Idaho contract for formulation, transportation and storage of the pesticide was awarded to Harbor Distributing Company of Portland, Oregon at the bid price of $0.754/gallon. The DDT itself was purchased by U. S. Forest Service Region 6 contract from Montrose Chemical Corporation of California at the price of $0.35/lb. As Harbor Distributing was the successful bidder for the pesticide formulation for the entire three state project area their formulation site was established at Walla Walla, Washington. Verification of dosage/gallon of the formulated spray was done at United Testing Laboratories, Pasco, Washington under guidance of the U. S. Forest Service Region 6 Pest Control rather than by the Idaho Department of Environmental and Community Services.

The formulated pesticide was delivered by the contractor and stored in two large holding tanks located in the Idaho Department of Highways yard at the junction of U. S. 95 and Alternate U. S. 95, Potlatch, Idaho. Arrangements for use of the site were made with Highway Department offices in Lewiston, Idaho. Payment to the contractor for the formulated pesticide was based on the amount delivered to Potlatch and metered into the storage tanks. The spray was again metered as it was taken out of the storage tanks, and as it was loaded from the nurse trucks into the spray ships. The following table summarizes the transactions.

TABLE 2

AMOUNT OF SPRAY IN GALLONS

77,348.8	-- Spray delivered to Potlatch
75,184.0	-- Transferred to nurse trucks from storage tanks
2,189.0	-- Unused and returned at termination of project
77,373.0	-- Sprayed or returned

The 24.2 gallon difference between the amount sprayed or returned and the amount delivered amounts to 0.03% of the total delivered. This difference is attributed to the fact that measurements of the gallonage delivered were corrected to 60°F, while measurements at the project site were not corrected.

Thirteen hundred acres of land that otherwise would have been sprayed with DDT were set aside to accommodate a last-minute request to test Sevin-4-oil. This accounts for 1,300 of the excess 2,189 gallons of spray.

As the treatment area was divided into spray blocks it was impractical to orient them according to elevation and aspect as planned. A much greater need existed to have well defined topographical boundaries that the spray pilots could easily recognize, hence the spray blocks were divided on prominent ridges and drainages.

Development and Population Sampling

Development sampling (Figure 2) started on May 23 and continued until June 21 when all blocks had been released for spraying. The initiation of egg hatching for all blocks stretched over an eight day period, June 12-19, with the majority of starts occurring between June 13 and 19 (Appendix 5).

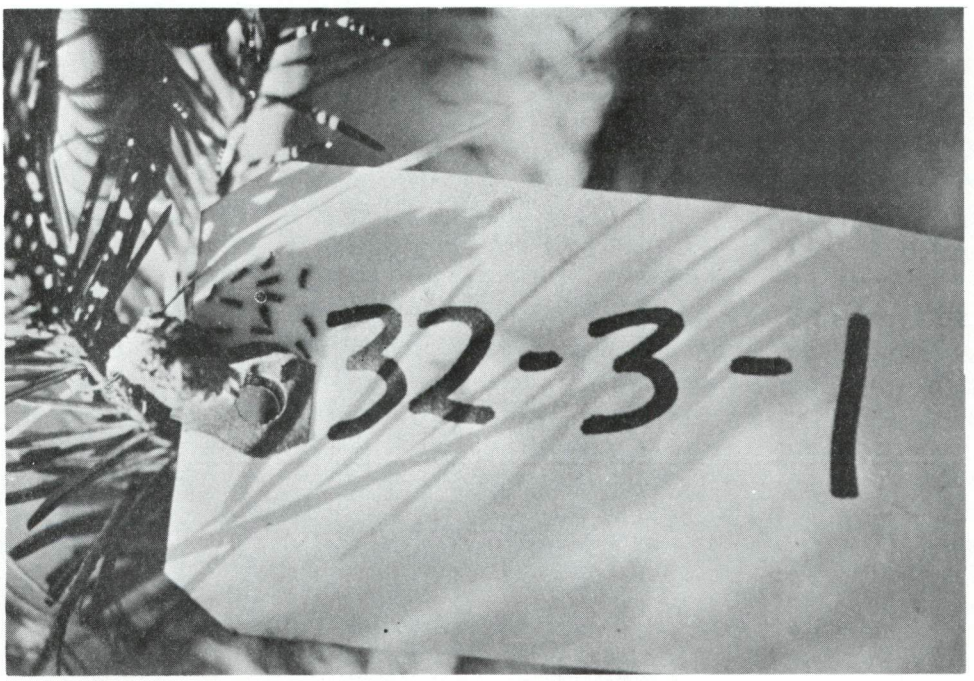


Figure 2.--Egg mass tagged and identified for development sampling. (Note 1st instar larvae on the tag.)

Achievement of egg hatch in 70% of the masses for all areas occurred from June 15-21, 1974 (Appendix 5), a period of seven days. This was much quicker than anticipated and caused problems with proper timing of the application. Because of the rapid hatch we were not able to treat most spray blocks on schedule. This led to a certain amount of damage to new growth that otherwise would have been avoided. It would have been desirable to have more spray craft capability available and thus be able to complete the project in a shorter time. We suggest a rate of 3,000 acres/hour.

The remoteness of many sample points and bad road conditions caused access difficulties in many areas. Use of two trail bikes (Figure 3) furnished by the BIA alleviated this problem. Their use would be recommended wherever such conditions exist. The four people working as development checkers were able to cover their assigned areas once every two days. Each had approximately one-fourth of the total plots to visit. This work load and schedule proved very satisfactory for the project. Having those persons assigned as development checkers locate the egg masses themselves would save time in the preparatory stages. Adequate training in observing for hatch is very important as the first instars often sit motionless on the egg mass and are very difficult to see.

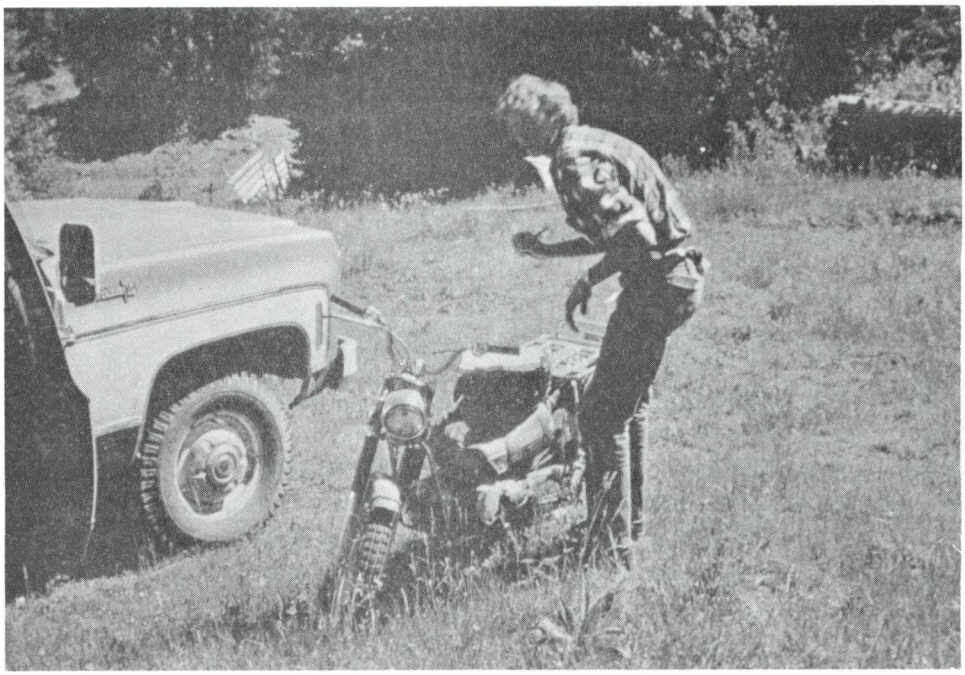


Figure 3.--Trail bike used for egg hatch development sampling.

Prespray sampling (Figure 4) revealed that the populations were lower than expected averaging 28.2 larvae/1,000 in.^{2} of foliage in the treatment area (Table 3). Several blocks were reduced in size due to low or missing populations (Appendixes 6 & 7). Low populations may have been due at least in part to the high incidence of the egg parasite Telenomus observed working on the egg masses before hatch. Visual evidence of virus was not observed. The crews assigned to population sampling were more than adequate for one 205 spray helicopter.

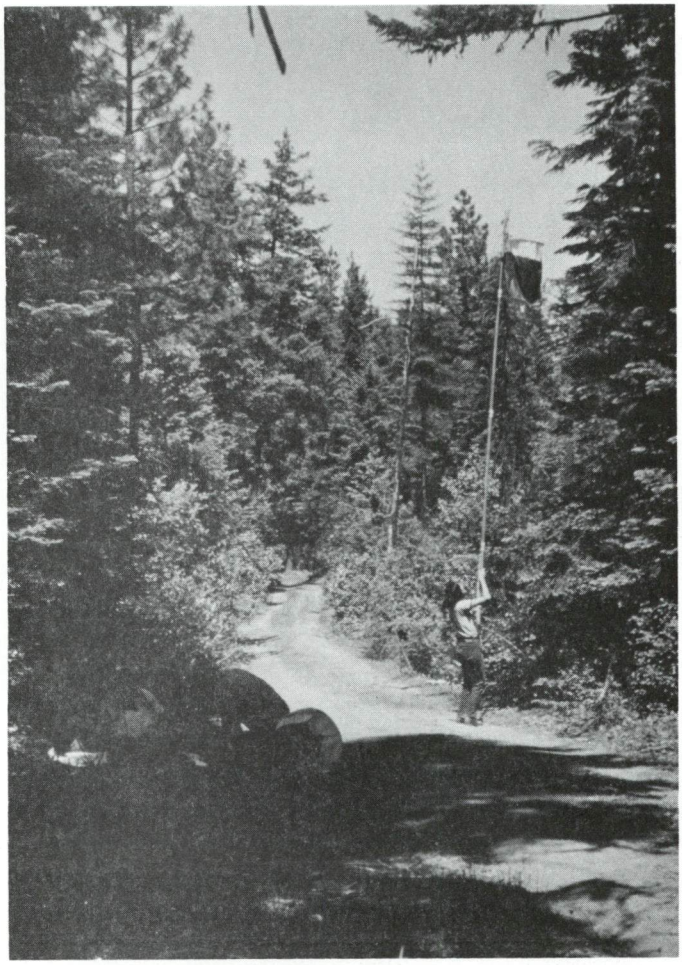


Figure 4.--Pole-pruner sampling of larval tussock moth populations.

TABLE 3

Douglas-fir Tussock Moth populations prior to and at 4 and 21 day intervals following DDT applications

Areas	EXAMINATION PERIODS		
	Prespray	4 Day Postspray	21 Day Postspray
	1/ 2/		
Treated	28.20 ± 5.22	0.55 ± 0.51	0.06 ± 0.06
Untreated	10.72 ± 1.69	9.40 ± 1.59	5.14 ± 1.49

1/ Larvae per 1000 in.^{2} of foliage.

2/ One standard error.

Entomological Evaluations

The entomological plan (Plan of Operations, 1974) outlined procedures which would evaluate the project in terms of (1) target insect mortality, (2) amount of foliage saved, and (3) density of new egg masses after treatment. The purpose of this evaluation is to document these findings.

(1) Insect Mortality

Tussock moth densities were calculated for the prespray, four days postspray, and 21 days postspray sampling periods and moth population per 1,000 square inches of foliage was computed for each of the 55 treated and 20 untreated clusters (Table 3). From this data mortality was obtained for each unit using Abbott's formula and survival ratios were computed as outlined in the entomological plan.

The effect of DDT on Douglas-fir tussock moth larvae was dramatic. The four day and 21 day postspray population measurements showed corrected mortality[1/] to be 97.8 and 99.8 percent respectively. An unpaired T test used to test differences in survival ratios between treated and untreated clusters for the 4 and 21 day postspray evaluations showed that population survival was reduced significantly because of treatment (Table 4).

TABLE 4

DOUGLAS-FIR TUSSOCK MOTH SURVIVAL RATIOS
BY TREATED AND UNTREATED CLUSTERS

	4-day Postspray Evaluation		
	Mean Survival Ratio	Degrees of Freedom	Student's T-ratio
St. Joe - treated	.00784 $\pm$ .0074[1/]	71	10.6 ***
St. Joe - untreated	.7868 $\pm$ .1186		

	21-day Postspray Evaluation		
	Mean Survival Ratio	Degrees of Freedom	Student's T-ratio
St. Joe - treated	.000876 $\pm$ .0009[1/]	71	6.47 ***
St. Joe - untreated	.3984 $\pm$ .1011		

1/ One standard error.
*** 1 percent significance.

1/ Abbott's formula was used which considers natural mortality in the check areas.

(2) Foliage Saved

Two methods were employed to show effect of treatment on the amount of foliage saved. One method (2a) detects differences in percent of needles damaged between treated and untreated areas on current years foliage 21 days after spray application. The other method (2b) measures visual differences in defoliation intensity between treated and untreated areas on both new and old growth at the end of the feeding period based on defoliation index.

(2a) Needle Damage at 21 Days after Spray Application

The percent of needles destroyed was obtained for each of the prespray and 21 day postspray sampling periods by counting damaged and undamaged needles from branch samples brought to the field laboratory (Figure 5).

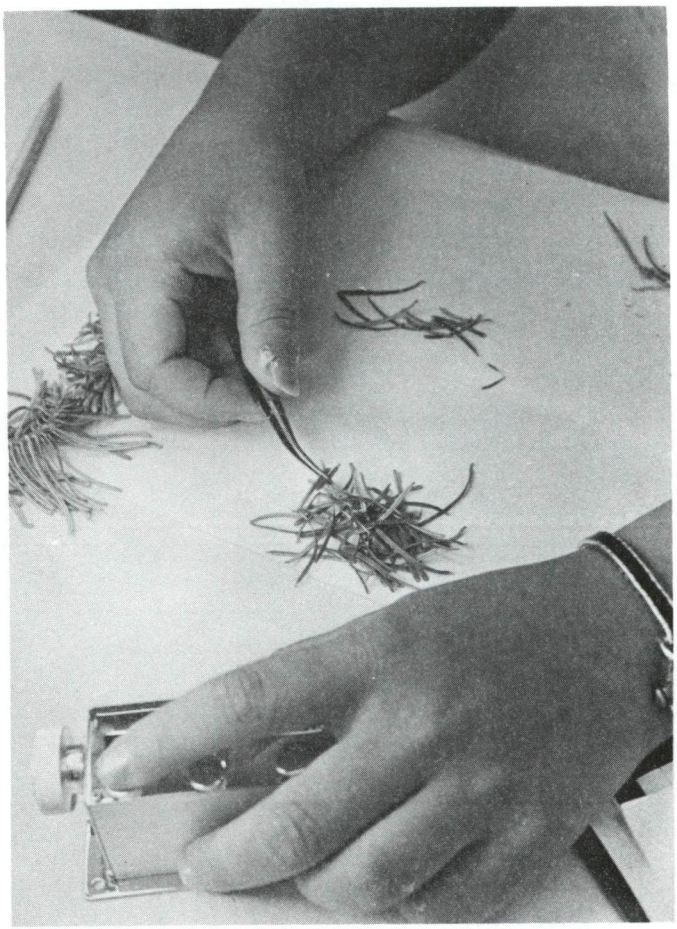


Figure 5.--Laboratory evaluation of damaged needles.

The percent needle damaged for each cluster was obtained and then transformed into arcsin to weigh more heavily the small percentages which have a small variance. Covariance analysis showed differences between treated and untreated areas and that new foliage was saved because of treatment (Table 5, Figure 6). There was approximately 20% more defoliation in the untreated than in treated areas 21 days after treatment. The analysis showed that the treatment was effective in preventing continued feeding in the treated areas whereas feeding did continue in the check areas.

TABLE 5

Covariance Test of Regression Lines Obtained from Measuring Damaged Needles at Prespray and 21 Day Postspray Intervals.

	Test for Differences in Slope			Test for Differences in Elevation		
	Regression Coefficient	Degrees of Freedom	F Value	Adjusted Means in Arcsin Transformation	Degrees of Freedom	F Value
a/ Prespray treatment	.1256	1/103	.127 NS	18.02	1/104	2.74 NS
21 day treatment	.1390			15.71		
b/ Prespray check	.4141	1/69	2.84 *	17.80	1/70	.069NS
Prespray treatment	.1256			17.40		
c/ Prespray check	.4141	1/36	3.73 *	16.16	1/37	.037NS
21 day check	.7869			15.71		
d/ 21 day check	.7869	1/69	7.956***	17.75	1/70	1.671NS
21 day treatment	.1390			15.00		

* 10 percent level
** 5 percent level
*** 1 percent level

NS - Non Significant

a/ test to determine if treatment failed to stop continued feeding.

b/ test to determine if feeding was more advanced in either check or treatment area prior to spray application.

c/ test to determine if feeding progressed in untested check areas.

d/ test to determine if feeding intensity was different between treated and untreated areas 21 days after treatment.

Figure 6

PERCENT OF NEEDLES DAMAGED ON CLUSTER TREES DURING THE PERIOD BETWEEN THE PRESPRAY AND 21-DAY POSTSPRAY EVALUATION PLOTTED BY PRESPRAY LARVAL DENSITY

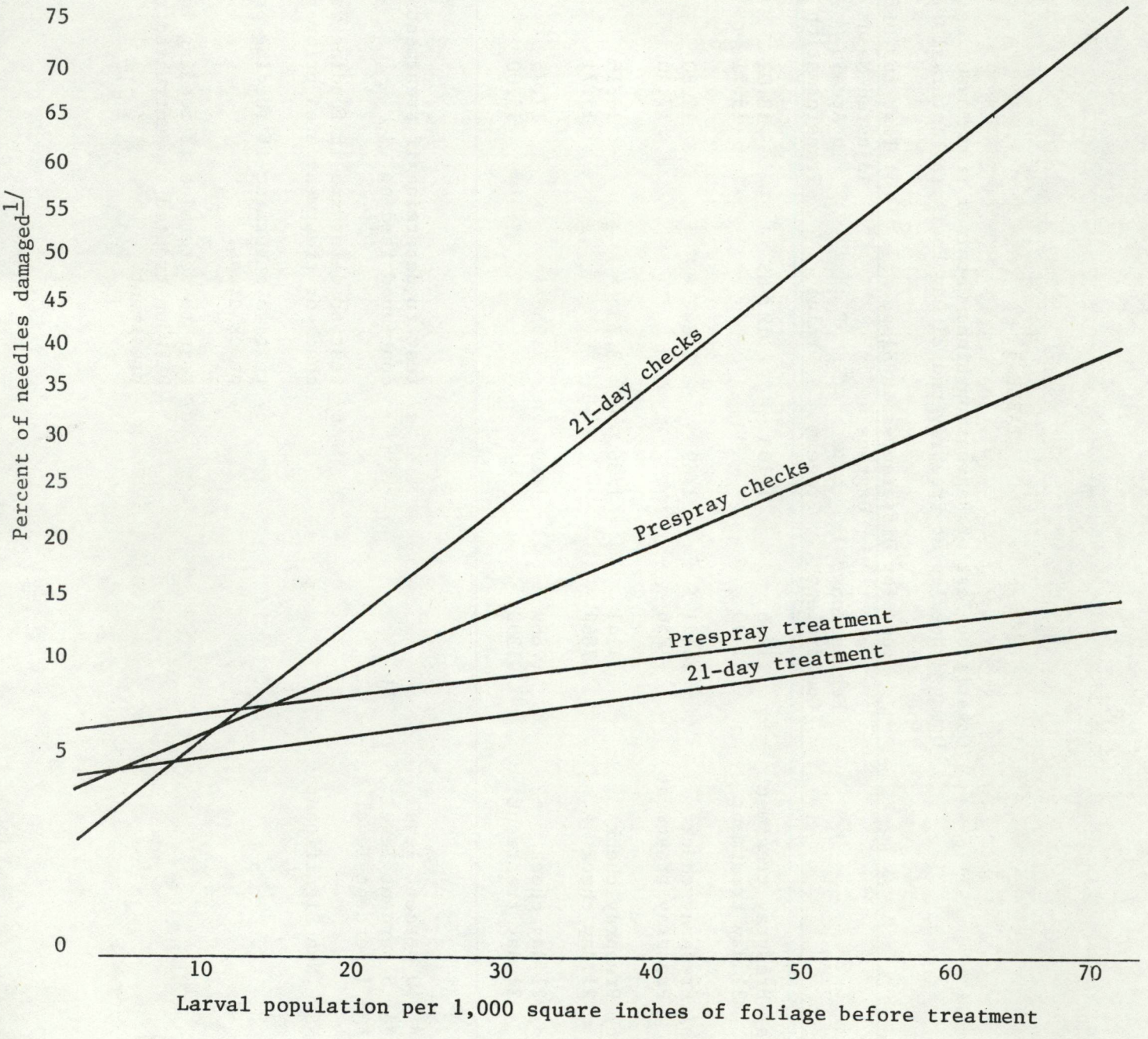
ST. JOE UNIT

Treatments:

Prespray	$Y = 14.4835 + .1257 * X_1$	$R = .608$ $F = 31.61$
21-day post	$Y = 11.7901 + .1390 * X_1$	$R = .532$ $F = 21.59$

Checks:

Prespray	$Y = 11.716 + .4144 * X_1$	$R = .638$ $F = 14.04$
21-day post	$Y = 7.4359 + .7869 * X_1$	$R = .745$ $F = 24.81$



1/ Percentages in arcsin transformation format.

(2b) Post Feeding Visual Defoliation Index

Prior to the spring feeding period each sample tree was rated as to existing defoliation intensity on old growth foliage. A defoliation index from 0-3 for each of six crown levels was visually measured on each sample tree and the mean defoliation index for the cluster was computed. This index was used as the base to determine if additional feeding on old growth foliage occurred in 1974. Post feeding examinations were conducted by the same individuals who made the pre-feeding examinations. Defoliation indexes for both old and new growth were obtained for each tree. The increase in defoliation index was calculated for all clusters. Covariance analysis was used to detect differences between treated and untreated areas.

After all feeding was completed the analysis showed that significantly more feeding occurred on the new growth in untreated areas than on the treated areas, although populations were not high enough in the untreated areas to show that old growth was saved (Table 6, Figure 7). There was a sevenfold reduction in defoliation intensities on new growth in the treated areas (Table 6).

TABLE 6

Covariance Analysis of Regression Lines Obtained from Visual Estimates of Crown Defoliation on the New and Old Foliage

	Test for Differences in Slope			Test for Differences in Elevation		
	Regression Coefficient	Degrees of Freedom	F Value	Adjusted Means 1/	Degrees of Freedom	F Value
NEW FOLIAGE						
Treated	.0239	1/69	12.57***	.3001	1/70	26.67***
Check	.1646			2.253		
OLD FOLIAGE						
Treated	.00068	1/69	1.033 NS	0.0415	1/70	.572 NS
Check	.00891			0.1232		

1/ Adjusted mean defoliation index for old growth foliage.

NS - Non significant

* 10 percent level
** 5 percent level
*** 1 percent level

Figure 7

AMOUNT OF VISUAL DAMAGE TO NEW AND OLD GROWTH FOLIAGE
EXPRESSED AS AN INCREASE IN DEFOLIATION INDEX ON
CLUSTER TREES PLOTTED BY PRESPRAY POPULATION LEVELS

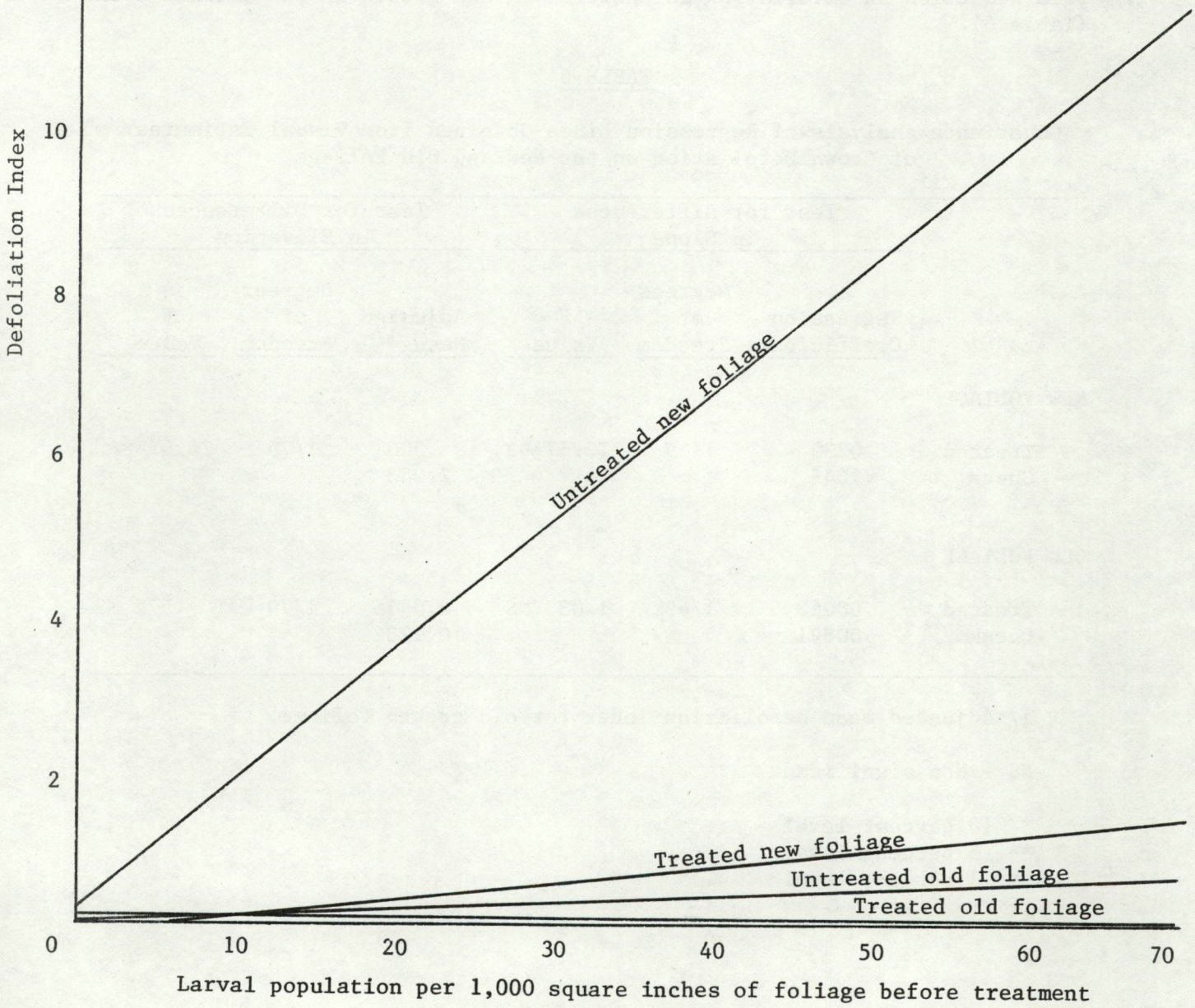
ST. JOE UNIT

Treated:

Postfeeding new foliage $Y_1 = -0.24640 + 0.023990 * X_1$ R = 0.648 F = 38.72
Postfeeding old foliage $Y_2 = 0.06299 - 0.006676 * X_1$ R = 0.055 F = 1.16

Untreated:

Postfeeding new foliage $Y_1 = 0.166780 + 0.16459 * X_1$ R = 0.545 F = 9.02
Postfeeding old foliage $Y_2 = 0.020939 + 0.00891 * X_1$ R = 0.194 F = 0.307



(3) Egg Mass Survey

Two whole mid-crown branches from each sample tree were removed in September-October and the number of new egg masses per 1,000 square inches of foliage was calculated on both treated and untreated areas. Results show that new egg masses were found in 3 of 20 check clusters but none in the 55 treated clusters. Two of the untreated clusters with egg masses are predicted as high risk for 1975 (Appendix No. 8).

Discussion and Conclusions

The results of the various analysis leaves little doubt that DDT was effective in reducing tussock moth populations to acceptable levels. The application also prevented needle destruction and new growth was saved because of treatment. The analysis showed that if high populations exist old foliage will also be saved. It should be pointed out that defoliation at mid-crown where evaluations were made is not representative of the most severely defoliated portion of the tree, but reflects the average. Research has shown that defoliation by the tussock moth causes a reduction in diameter growth at all levels of tree height examined, but is most pronounced in the upper part of the tree where feeding damage is normally heaviest. In previous studies areas of heavy defoliation suffered a 63.5% growth reduction in the merchantable size trees. Growth recovery in unkilled trees was not complete until the fourth and sometimes fifth year (Wickman, 1963). As many as half of the trees that have 50 to 75 percent of their crowns defoliated suffer top-kill (Wickman, 1963).

Bark beetles are also a potential threat to the trees weakened by defoliation due to the tussock moth. In one infestation 75% of the total tree mortality was due to attack by beetles. This type of mortality continued for four years after defoliation and occurred primarily in merchantable sized trees (Wickman, 1958). Salvage programs can harvest mortality and weakened trees but are disruptive to the orderly harvest of the forest.

Foliage protection in 1974 should prevent growth loss, top-killing, and tree mortality due to attack by other organisms and thus help maintain a healthy, green forest.

Spray Deposit Assessment

Spray deposit card lines were established in each block as described in the project operations plan and left in the field for no longer than 18 hours. Exceptions occurred in spray blocks 14, 17, 18, 19 and 26 where lines were left in the field for 30 to 40 hours as a result of delays or changes in the spraying schedule.

To insure an adequate sample of the spray deposit pattern, we had initially intended to establish the card lines at right angles to the line of flight of the spray ship. In practice this proved to be impossible, due to the rugged, often inaccessible terrain encountered, time limitations, and the impossibility of predicting what pattern the spray ship would fly. Due to these limitations, most of the lines were established along roads and skid trails. Several were located along open ridge tops, and one or two beneath heavy overstory timber.

Card lines were also established to assess spray deposit levels adjacent to buffered, sensitive streams (Figure 8). Ten cards were set out at 20-foot intervals on each side of the stream perpendicular to the flow. Each card was labeled with the stream name and a number indicating its position in the card line. They were usually set out early in the morning just prior to spraying. Because of limitations of available time and manpower no attempt was made to monitor every buffered stream in the project area. Card lines were established on 15 of the 30 streams designated as sensitive.

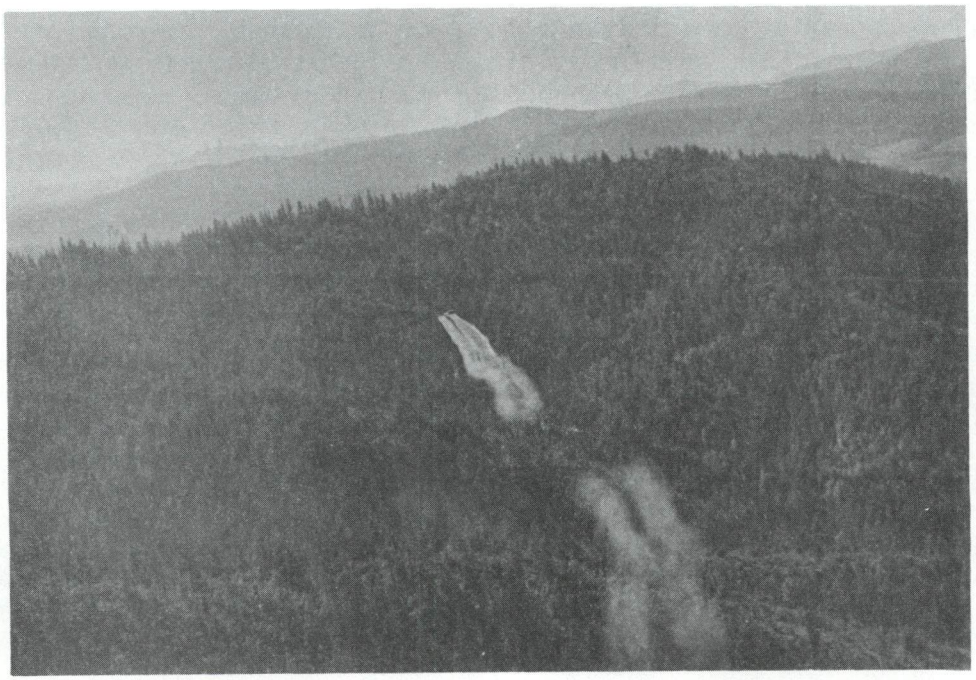


Figure 8.--400-foot break in the spray swath over a buffered stream.

The average deposit for the project as a whole was 0.41 gal./acre (Table 7). Deposit recorded for blocks 8, 10, 17, 24 and 28 was below the 0.2 gal./acre established as the minimum acceptable deposit (Plan of Operations, 1974). Most of these, however, were very close to acceptable levels, and were considered satisfactory on the basis of aerial observer reports that the applications appeared to be adequate and uniform.

Of the fifteen streams checked significant stream-side spray deposit was recorded in three: Boulder Creek, Hangman Creek, and Bunnel Creek (Table 8). Although wind drift may have been a contributing factor in Bunnel Creek where spraying was terminated because of wind, most of this accidental deposit probably resulted from human error.

The main difficulties encountered were associated with the unexpectedly rapid egg hatch and fluctuating weather conditions characteristic of the project. Once the eggs began hatching, it often became necessary to lay out and retrieve card lines from as many as eight separate blocks each day; and often, because

TABLE 7
SPRAY DEPOSIT SUMMARY

Spray Block Number	Gallons of Insecticide Sprayed	Spray Deposit (Gal./Acre) Card Line No. 1	Card Line No. 2	Average Deposit
1	860	0.02	0.96	0.49
2	3,600	0.56	0.42	0.49
3	2,700	0.54	0.65	0.59
4	1,800	1.19	0.47	0.83
5	1,500	0.51	0.39	0.45
6	1,200	No data -- most of block not sprayed.		
7	1,600	0.34	0.27	0.30
8	2,200	0.13	0.03	0.08
9	2,550	0.48	0.45	0.46
10	1,750	0.35	0.04	0.19
12	1,700	0.27	0.12	0.20
13	1,300	0.46	0.10	0.28
14	1,600	0.33	0.57	0.45
15	2,600	0.33	1.17	0.75
16	3,700	0.31	0.41	0.36
17	2,100	0.04	0.27	0.15
18	2,100	0.41	0.19	0.60
19	4,200	0.66	0.38	0.52
20	2,100	0.68	0.52	0.60
21	1,200	0.43	0.55	0.49
23	1,850	0.35	0.73	0.54
24	2,700	0.29	0.05	0.17
25	2,100	0.46	0.30	0.38
26	4,250	0.64	0.18	0.41
27	4,350	0.26	----	0.26
28	2,640	0.03	0.34	0.18
29	1,250	0.29	0.61	0.45
30	1,550	0.23	0.21	0.22
31	2,900	0.49	0.37	0.43
32	1,975	0.61	0.44	0.53
33	3,350	0.24	0.45	0.35
34	-----	No data -- block used for Sevin test.		
35	3,979	0.27	0.45	0.36
Totals	75,254	Average Deposit = 0.41 Gal./Acre		

TABLE 8

SPRAY DEPOSIT DATA - BUFFERED STREAMS

Spray Block Number	Stream Name	Spray Deposit (Gal./Acre) Streamside *	Ave. for Line **
3	W. Fk. Deep Cr.	0.00	0.01
3	W. Fk. Deep Cr.	0.00	0.00
7	E. Fk. Deep Cr.	0.07	0.04
9	Gold Cr.	0.03	0.03
10	Gold Cr.	0.00	0.00
10	E. Fk. Gold Cr.	0.00	0.02
12	Boulder Cr.	0.55	0.30
13	Jerome Cr.	0.00	0.00
13	Jerome Cr.	0.00	0.01
14	Big Cr.	0.00	0.00
14	Big Cr.	0.00	0.00
17	Prospect Cr.	0.00	0.00
18	Meadow Cr.	0.00	0.00
19	White Pine Cr.	0.03	0.04
19	White Pine Cr.	0.00	0.00
19	Blakes Fk. Cr.	0.00	0.00
20	Mannering Cr.	0.00	0.00
20	Mannering Cr.	0.00	0.12
20	E. Fk. Meadow Cr.	0.00	0.01
21	Hangman Cr.	----	0.76
23	Bunnel Cr.	0.85	0.73

* Stream and 20-foot strip on either side.
** Stream and 200-ft. strip on either side.

of weather conditions, lines had to be replaced several times before the blocks were actually sprayed. In some cases, as mentioned previously, this resulted in lines being left in the field for excessive periods of time. Last minute changes in spray block priorities also caused some confusion and wasted time.

Other problems encountered were relatively minor. In one block (line 32-2) a card was run over by a passing logging truck, and another six were apparently eaten by cows (line 32-1). Cows are also assumed to have devoured all but two cards on another line (8-1). Over-exposure and fading of cards left in the field for excessive periods of time caused some difficulties in evaluating spray deposit. These problems, however, were secondary to the larger problems outlined above, and could have been greatly reduced if field crews had always possessed the capability to set out lines just prior to spraying.

Most of these problems could have been alleviated by additional manpower on the spray deposit crews. A foreman, two 2-man line crews and personnel shifted from other crews just managed to keep ahead of the spray ships. In some instances these crewmen were up at 3:00 A.M. and did not finish for the day until 5 or 6:00 P.M. In other instances, they laid out card lines at a run in blocks where spraying was in progress.

Under conditions similar to those encountered on this project, a foreman, three 2-man line crews and a full-time stream monitoring crew could efficiently monitor spray deposit. This crew organization would provide the flexibility needed to meet unexpected contingencies associated with the project.

Early reconnaissance and marking of line locations is essential for efficient spray deposit monitoring and should be done as early in the project as possible. Sending crews to set card lines in unfamiliar areas is unsatisfactory. In this project the foreman spent most of his time establishing line locations at the expense of closer supervision and direct involvement in laying out card lines.

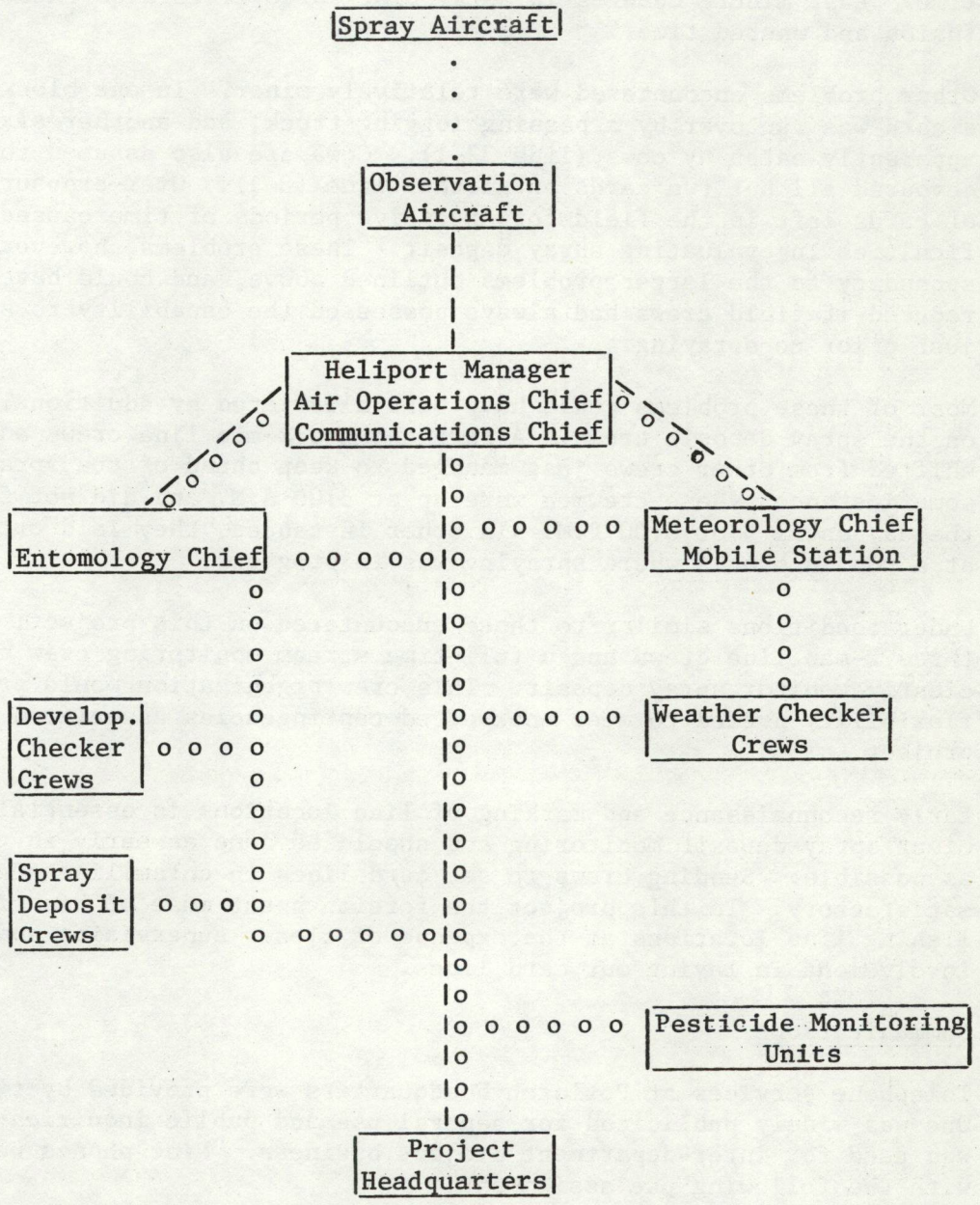
Communications

Telephone services at Potlatch headquarters were provided by two lines. One was widely publicized for general use and public inquiries; the other was used for inter-department project business. Nine phones were installed with the following use assignment:

1. Project Director
2. Monitoring Liaison
3. I & E Officer
4. Admin. Officer
5. Asst. Project Director
6. Dispatcher
7. Air Operations Chief
8. Entomology Chief
9. Extra for misc. use

The radio system was based on three separate nets (Figure 9):

FIGURE 9
TWO WAY RADIO COMMUNICATION INTER-TIE



3 Radio Nets Used

VHF - Discreet frequency assigned by FAA . . . . .
USFS - Clearwater National Forest – – – – –
State - BIFC Fire frequency o o o o o

In addition to units indicated above, state portables were assigned to Director and Asst. Director, Safety Officer, Monitoring Liaison, and Asst. Entomologist.

1. VHF system on discreet frequencies assigned by FAA--Spray aircraft to observer aircraft.

2. Clearwater NF net--Observer aircraft to heliports, operations chief mobile and headquarters base station.

3. State net (Boise Inter-agency Fire Center units, two 16-unit kits)--Entomology, Weather, Spray Deposit and Residue Monitoring.

Portable repeaters for the forest and BIFC nets were placed on Bald Mountain. The BIFC repeater was later moved to Gold Hill for better service.

Pesticide Residues Monitoring personnel initially requested Forest Service net radios to instruct aircraft in cases of misapplication, to monitor spray operations radio traffic, and to coordinate residue monitoring activities. The director did not feel this was an acceptable procedure. Responsibility for aircraft and air operations performance and safety was considered solely that of the aerial observers and air operations chief. Ground observations of spray drift or misapplication, if any, were to be reported directly to the air operations chief by entomology and weather crews and, if critical, transmitted to the observer aircraft. To insure safety and radio traffic discipline, only the observer aircraft would be allowed to communicate with the spray aircraft. Therefore, the monitoring section was furnished state net radios to conduct their work, to monitor radio traffic for accidents, spray drift, weather, and locations of crews and to contact headquarters.

If two or three spray and observer aircraft had been working, FAA radio assignments of discreet frequencies would have been needed for each spray-observer aircraft team. On two occasions interference occurred on the VHF discreet frequency from either the Pomeroy or Colville spray project. The FAA was notified and subsequently changed the assigned frequency.

The BIFC radios were modern and worked perfectly for the project. However, the stringent agreement between BIFC and the State provided them only on the basis of 24 hour notice of recall by the fire supply agency. On July 2nd they were recalled. Due to the sensitivity of the spray project and vital need for good radio equipment it is imperative that future priorities of radio use be secured to avoid loss of a good radio system.

The replacement of the BIFC-State net with Region One fire cache radios terminated effective ground communication. This network usually failed to work unless the radios were within 2 miles and in line of sight to the repeater.

Air Operations

A contract for helicopter application of insecticide was advertised by the U. S. Forest Service to spray 54,000 acres. Evergreen Helicopters, Inc., was the lowest bidder at $2.14 per acre which included labor and loading equipment. Biological evaluations later in the spring increased the spray area to 82,000 acres and the additional acreage was negotiated for at the same bid price.

The contractor provided a Bell 205 (Figure 10) as the spray ship which had the capability of spraying 1,000 acres per hour. Evergreen brought in another Bell 205 at the end of the project to complete the contract. The contractor provided a 5,000 gallon nurse truck and service truck.

Calibration was accomplished one day before spray operations began. The ship was calibrated to apply one gallon per acre with a swath width of 200 ft. when flying 90 miles per hour (Figure 11). Spray boom times were kept and a minor adjustment in the number of nozzles was made on the second day of operation.

A Bell 206 helicopter under contract with the State of Idaho at $235.00 per hour was used as an obervation ship (Figure 12) for a portion of the spray period, and a B2 helicopter under contract by the U. S. Forest Service at $132.85 per hour served as the other observation helicopter. Total flight hours for spray craft and observation craft are shown in Table 9.

TABLE 9
ACRES SPRAYED AND HOURS OF HELICOPTER FLIGHT TIME BY DATE

Date	Acres Sprayed	Spray Helicopters		Observation Helicopter	
		No.	Flight Hours	No.	Flight Hours 1/
June 19	1,975	1	1.8	2	9.4
20	2,975	1	2.1	2	5.1
21	4,600	1	3.0	1	5.3
22	1,200	1	1.2	1	2.5
23	4,800	1	3.7	1	5.9
24	3,600	1	2.7	1	4.6
25	3,900	1	4.2	1	8.7
26	300	1	0.2	1	0.9
27	4,200	1	3.0	1	5.4
28	1,300	1	1.6	1	2.4
29	3,900	1	2.5	2	8.2
30	3,900	2	3.0	2	7.1
July 1	300	1	0.3	2	1.8
2	6,900	2	4.8	2	10.7
3	6,350	2	5.6	2	10.7
4	2,200	2	2.3	2	3.9
5	3,600	2	2.7	2	7.0
6	8,700	2	5.9	2	11.0
7	7,804	1	4.8	2	10.8
8	2,250	1	2.0	2	6.3
TOTALS	75,254		57.4		127.7

Acres sprayed per flight hour - 1,311.0.

1/ Includes both observation and reconnaissance flight hours.

Figure 10.-- Bell 205 spray ship.

Figure 11.-- Bell 205 spray helicopter in operation.

Figure 12.--Bell 206 Jet-Ranger observation helicopter.

Heliport sites were located with assistance from local personnel and checked by the air operations chief. Use agreements were obtained for each site and payment was provided for hay crop damage when necessary. Portable toilets were provided at each heliport. Large open fields were used in all cases and were located at strategic points to minimize ferry distance (Figure 13) which was usually less than 3 miles. The service approach to the helicopter area was roped-off for safety purposes. A total of 10 heliport locations were utilized (Appendix No. 7).

Heliport managers were given formal and on the job training before spray application. The managers had the responsibility to maintain a record of insecticide applied to each spray block and the time helicopters were airborne. They also maintained a load manifest for each helicopter and were responsible for safety at the heliport.

The Air Operations Officer Callaway (Figure 14) and an assistant, F. Andres, directed all phases of air operations and were responsible for planning spray application as spray blocks were released by the unit entomologist.

In places where difficulty might be encountered in recognizing an excluded area or sensitive zone, smoke grenades were set off by spray deposit or weather checking crewmen and others. They were especially dispatched to mark spray swath boundaries as the spray helicopter approached. These observers and some of the residue monitoring personnel were equipped with state-net radios and could report improper drift of spray to the air operations chief who could immediately relay to the observer aircraft.

Figure 13.--Brown's Meadow heliport, first day of spraying.

Figure 14.--Air operations briefing.

Observers in the observational helicopters assisted the spray ship to maintain uniform coverage, point out sensitive streams and spray block boundaries. They also provided information on accomplishment when only a portion of a spray block was completed at the end of a spray day. Usually the aerial observer and spray pilot would fly a reconnaissance flight on the next spray block to familiarize themselves with boundaries and sensitive areas. Aerial photos at the scale of 1" and 2" to the mile were provided to the spray craft pilots and aerial observers. The spray pilots preferred the 1" to the mile scale and the aerial observers used the 2" to map progress while in the air. Good quality photography was not available on a portion of the Moscow Mountain area and 1" topographic forest type maps served as a poor substitute.

The other assistant air operations officer, Gravelle, was responsible for insecticide transfer and maintained all records of the air operations phase. A progress map was updated daily and cumulative total of insecticide sprayed and on hand was logged. Spraying continued every day from June 19th to July 8th although there were two days when only 300 gallons were applied (Table 9). The amount of insecticide applied to each block and the date sprayed was recorded (Table 7, Appendix 5).

Problems in maintaining a fixed-distance buffer strip arose. Adjustments were made to protect buffered streams depending on topography and air currents. If there was a down-canyon drift, application was made higher on the slopes to prevent or minimize spray deposit in streams. In some cases the buffered areas were more than 200 feet on either side of the stream, and in some cases less. A total of 30 streams were buffered, all relatively small or medium-sized creeks.

Meteorology

Two meteorologists from Missoula, A. F. Burnham and Dave Goens, were assigned to the project by the U. S. Weather Service of the Department of Commerce. They brought two fire weather mobile units, the first a weather service unit and the second loaned by the State of Montana forestry division (Figure 15).

During the last four days of May the meteorologists tested their equipment, trained the four weather crewmen and studied the project maps and terrain of the spray blocks. Each weather crewman was issued a belt weather kit, versed in their use and in reporting properly to the spray block meteorologist.

The meteorologists were released on May 31 and called back to Potlatch on June 16 after egg hatch started. One meteorologist with a mobile unit operated alongside headquarters where weather condition reports were monitored continuously from stations around the Northwest. The other unit was driven to the proposed spray blocks prior to 0330 PDT. The headquarters unit provided base station consultation for the project staff and relayed important changes to the spray block unit. The mobile unit in the spray block would collect the weather observer reports from predetermined locations throughout the spray block and relay them to air operations every 30 minutes. These observations included temperature, humidity, wind, wetness of foliage and signs of precipitation. About 0400 the air operations chief would contact the spray block meteorologist for an initial go or no-go determination. If

Figure 15.--Planning weather observation operations.

the word was go, spraying would commence between 0430 and 0500 and continue until winds or temperatures of 6 MPH or 70°F required a shutdown. When conditions approached the critical stage the observations from the block weathermen were reported every fifteen minutes. The shortest spray day was fifteen minutes, the longest was eight hours.

Decisions on where to start spraying and when were always made in consultation with the block meteorologist. Air operations relied heavily on the weather section for shutdown times and other information such as ground observations of stream buffering effectiveness and spray drift patterns.

Upon completion of spraying for the day the block meteorologist and his crewmen would scout the spray blocks planned for spraying during the following day(s). They would locate suitable observation sites and the least difficult access for pre-dawn driving by each of the weather crewmen. Familiarity with the small scale terrain in the blocks was gained during the scouting period. This helped in forecasting critical heating and wind regimes that affect the spray operation.

The headquarters meteorologist started working at 0545 PDT. As well as monitoring weather data radio and providing headquarters consultation previously mentioned, he provided the spray forecast for the following morning. This was prepared by 1700 PDT and given with a briefing to the project director or assistant. They in turn took copies to quarters in Moscow for the air operations personnel and entomology chief.

On June 29 the meteorologists decided that one of the weather crewmen could

serve as the block weather foreman replacing the block meteorologist and Burnham returned to Missoula for a four day rest. Burnham returned on July 2 relieving Goens for the remainder of the project. Had only one meteorologist been assigned to the project, the hours of effort required daily (until the assigned foreman became satisfactorily proficient) would have been too much for one person.

The daily forecasts verified very well, there being two days when operations were cancelled due to weather without accomplishing a reasonable amount of spraying. On one of these days the forecast was definitely unfavorable (June 26). On the other the forecast was marginally favorable and operation time was predicted to be short due to wind. It was (July 1).

Residue Monitoring

An extensive monitoring program to measure the levels of DDT before, during and after spray application was administered by the Idaho State Department of Environmental and Community Services with cooperation from the Departments of Fish & Game and Agriculture. This program was coordinated with similar projects in Washington and Oregon by Rod Canutt, U. S. Forest Service, Portland, Oregon. The project was assigned a monitoring liaison whose principal duties were to: (1) provide information on current spraying plans, (2) develop a communication system permitting timely transmission of project spray plan changes to monitoring personnel, (3) receive and log biological samples and ensure that samples were properly stored, (4) coordinate monitoring of accidental pesticide spills, (5) coordinate damage claims investigation, (6) inspect operational areas and procedures to insure that undue environmental contamination was avoided, (7) provide information relating to the monitoring program to visiting scientists, (8) provide assistance in collecting samples, and (9) maintain a complete log of daily activities pertaining to the monitoring program (USDA Environmental Statement, March 1974).

Monitoring Studies

Major monitoring efforts on the St. Joe project were directed at evaluating DDT residues in water, fish and air; and at assessing the effect of DDT on parasites of the larch casebearer. Aspects of this study included: (1) evaluation of 94 water samples from various streams in the spray area; (2) evaluation of tissue samples from coyotes, adult trout, fingerling trout, chipmunks, aquatic invertebrates, grouse, juncos, robins, and white-footed mice; (3) evaluation of forest litter samples; (4) air monitoring studies by Washington State University; and (5) an evaluation of the effects of DDT on predatory bird populations by the Fish & Wildlife Service.

Buffered Areas

Buffered areas established on the St. Joe unit included the larch casebearer multiple-parasite release center on Deep Creek, forest residential areas, ponds, springs, sensitive streams and private lands as requested by landowners. Sensitive streams were designated initially on the basis of recommendations by the Idaho Fish & Game Department, as recorded on maps sent to Coeur d'Alene on May 10 by Stacy Gebhards. This was in response to a previous request from the project director. The project staff later designated

several additional streams for buffering, including those areas added to the spray blocks during the project and others that appeared similar to streams previously recommended by the Fish & Game Department.

DDT Residues in Livestock and Big Game

On Steptember 19, 1974 the U. S. Animal Plant Health Inspection Service, Forest Service, and Idaho State Department of Agriculture held a meeting in Boise and announced an extension of the period over which meat from the spray areas would be inspected for DDT residues from December 1974 to March 1, 1975. Livestock producers were asked to keep an account of animals exposed to DDT and to hold them from market until after March 1. Under this inspection program the producer had the option of having his animals tested prior to slaughter, at his expense. If untested animals were marketed and subsequently found to have residue levels in excess of 5 ppm, the carcass would be disposed of and financial problems could arise between the producer and the packer.

This extension of the inspection period resulted from a decision by the EPA on August 13, 1974, to lower the acceptable level of DDT residues in meat from 7 ppm to 5 ppm. National environmental groups had previously corresponded with the Forest Service, EPA and Department of Agriculture urging that inspection programs be established to ensure that meat with DDT residues in excess of established tolerances would not be marketed.

To locate potentially high-residue cattle the State Dept. of Agriculture asked the project director to furnish a list of livestock producers in the project area. Although such a list did not exist a list of the 195 individuals owning land in the sprayed area was provided. The Dept. of Agriculture, through local information, brand registration and other means, hoped to determine which of the 195 forest owners were livestock producers.

To date no evident local problems have developed in the St. Joe unit due to DDT residues in marketed livestock. Although cattle were seen locally during the project on Moscow Mountain, Gold Hill, East Dennis Mountain, and west of Crane Point, grazing was limited in the spray blocks due to the low forage value of the forest types involved.

As specified in the impact statement, hunters were also advised of the possibility of excessive DDT residues in elk and deer taken in or near the spray area. Prior to the big game season in Idaho, press releases warning of this possibility were provided to radio and news media, and maps showing the sprayed areas were prepared for distribution.

PROJECT COSTS

$435,675.07 has been expended to date on the control project (Table 10). Actual costs on a per acre basis are $5.79 (Table 11). With the addition of an estimated monitoring cost of $1.22 per acre, prepared in February 1974, the total projected cost would be $7.01 per acre. However, all monitoring work chargeable to the project will not be completed until fall, 1975.

Table 10

Distribution of Expenditures by Organization[1/]

	State Department of Lands	U. S. Forest Service[2/]	Totals
Spray Helicopter	-----	$160,238.34	$160,238.34
Observation Helicopters	$ 21,314.50	13,298.31	34,612.81
Fix-Wing (Administration)	-----	1,099.76	1,099.76
Insecticide - 77,349 gal.	58,321.00	20,304.06	78,625.06
Administration	66,637.69	34,877.65	101,515.34
Mileage & per diem	34,513.68	11,202.52	45,716.20
Miscellaneous	6,589.79	4,017.11	10,606.90
Capital Expense	3,260.66	-----	3,260.66
TOTALS	$190,637.32	$245,037.75	$435,675.07

1/ State agencies responsible for pesticide residue monitoring estimated costs of $61,240.38 or $1,224 per acre (meeting with USFS, Dept. of Lands and DECS, Feb. 5, 1974). Expenditures billed to date are for laboratory analysis of samples only and are $8,473.50. Actual costs will not be finalized until fall, 1975.

2/ Includes BIA expenditures of $4,114.00 salaries; and $2,502.00 mileage and per diem.

Table 11

Summary of Costs for St. Joe Tussock Moth Project--75,254 Acres

Items	Total	Per Acre
Evergreen 205 Helicopter (USFS)	$160,238.34	$2.1293
DDT Purchase @ $0.35/lb. (USFS)[1/]	20,304.06	0.2698
DDT Formulation @ $0.754/gal. (State)[1/]	58,321.00	0.7750
206A Observation Helicopter (State)	21,314.50	0.2832
B2 Observation Helicopter (USFS)	13,298.31	0.1767
Fixed-Wing Aircraft (USFS)	1,099.76	0.0146
Administration (State)	66,637.69	0.8855
Administration (USFS)[2/]	34,877.65	0.4635
Mileage and Per diem (State)	34,513.68	0.4586
Mileage and Per diem (USFS)[2/]	11,202.52	0.1489
Miscellaneous (State)	6,589.79	0.0876
Miscellaneous (USFS)	4,017.11	0.0534
Capital Expense (State)	3,260.66	0.0433
TOTALS[3/]	$435,675.07	$5.7894

1/ 77,349 gallons of DDT pesticide formulation were purchased and an excess of 2,189 gallons was returned to Walla Walla.

2/ Includes BIA salaries of $4,114.00 and mileage & per diem of $2,502.00.

3/ Does not include monitoring costs. State agencies responsible for pesticide residue monitoring estimated costs of $61,240.38 or $1.224 per acre (meeting with USFS, Dept. of Lands and Dept. of Environment & Community Services, Feb. 5, 1974). Expenditures billed to date are for laboratory analysis of samples only and are $8,473.50. Actual costs will not be finalized until fall, 1975.

These costs are considerably higher than the $133,624.30 or $1.11 per acre incurred in the 1965 Idaho spray project (Scribner, 1965). Project cost estimates, compiled in February 1974, indicated expenditures of $4.83 per acre for control operations and $1.22 per acre for pesticide residue monitoring, for a total of $6.05 per acre. The reasons for the higher costs over those of 1965, in addition to inflation, included: (1) the higher cost of helicopter spraying with full-time observation helicopters as compared to fixed-wing spraying, (2) increased expenditures for the more thorough analyses of pre and post spray tree condition, foliage damage and pest populations deemed necessary, and (3) the increased personnel requirement needed to meet the stringent self-imposed pesticide safety and application criteria established for the project.

The financial burden of a control project of this kind is shared by private, state and federal forest owners. The Idaho Code Annotated, Chapter 38 Section 408, provides that, "....five percent of monies hereafter collected for disposal of logging slash for the reduction of fire hazard shall be allocated to a special account for forest insect and forest pest abatement and control.... and shall be deemed to be the contribution of the owners of private lands to the abatement and control programs....." Thus, payments for slash disposal from forest products harvesting has pre-paid the private landowners' share of the control project costs whether they have done any harvesting in the recent past or not. Timber harvesting on state-owned lands also contributes to this fund.

An additional emergency appropriation of $477,450 was passed by the 1974 Session of the Idaho State Legislature to cover estimated project costs beyond the capability of reserves in the state Pest Control Fund. U. S. Forest Service matching funds provide for 50 percent of the costs incurred on state and private lands in the project area and 100 percent of the costs incurred on federal and Indian lands (Table 12). A special congressional appropriation of approximately $3,018,000 was also passed to supplement Forest Pest Control Act funds previously designated for the entire project in Idaho, Oregon and Washington.

Table 12

Tentative Project Cost Obligations
for Idaho Dept. of Lands and U. S. Forest Service Pest Control Funds

Ownership	Acres Sprayed	Cost Share per Acre 1/	$ Obligations IDL	$ Obligations USFS
National Forest	17,200	$5.7894	---	$ 99,577.68
Coeur d'Alene Indian Res.	3,088	5.7894	---	17,877.67
Private	47,366	2.8947	$137,110.36 2/	137,110.36
State of Idaho	7,600	2.8947	21,999.72	21,999.72
TOTALS	75,254		$159,110.08	$276,565.43

1/ Does not include DDT Residues Monitoring Costs.

2/ Potlatch Corporation donated services and expenses of Paul Gravelle, Assistant Air Operations.

RECOMMENDATIONS

1. Large and adequate office space was an invaluable asset to the project. There was about 200 sq. ft. in the Potlatch High School Vocational Building for each staff and field officer.

2. Monitoring personnel were not directly attached to nor clearly identified with the spray project. Monitoring units were late in getting started and appeared to lack coordination until late in the spray program. A field residue monitoring chief, with personnel from monitoring agencies, should have been placed within the project under project direction and funding. Then monitoring personnel would have been acquainted with the project from its inception and some duplication of project expenses in transportation and supplies could have been avoided.

3. Many of the spray blocks were not treated according to the planned time schedule. The project work plan called for spraying each block three days after achieving initiation of egg hatch in 70% of the egg masses. It was anticipated that this would occur over a span of 15-18 days. With this anticipated hatch in mind the contract for spraying stipulated a daily capability of not less than 3,000 acres. In actuality 70% egg hatch and subsequent release of spray blocks occurred over the space of only seven days. Considering the potential for reoccurrence of this problem in future projects the capability to increase daily spray production enough to maintain pace with the development of the insect is needed. This might be accomplished through contracting, by having the option to ask for and receive more spray aircraft if needed.

4. Although no losses of valuable equipment occurred, we were frequently concerned about the number of strangers loitering in our headquarters building. Most of these turned out to be college student crewmen of monitoring units arriving in Potlatch for a certain study, or waiting to meet someone. The project monitoring liaison was named field coordinator for monitoring and did much field work himself to insure that sampling was done. Therefore, he was often absent from headquarters and accomodation of these monitoring units was provided by other project staff. A project monitoring chief, as mentioned in Item 2, could have alleviated this problem.

5. Some problems developed as state permanent and part time employees working together with Forest Service employees discovered some differences in salary and overtime provisions. Seasonal state employees were paid time and one-half for overtime while most permanent employees were not. Some Forest Service personnel received additional hazard pay for low level flying involved with the helicopters while State employees did not. Generally the differential between federal and state renumeration was accepted. The difficulties were primarily those involved between lower grades of state employment in permanent and temporary service.

   Should a future cooperative program be initiated, the State should compile a salary plan for the project. This plan should anticipate the morale factor of any differences so they can be explained to employees prior to project assignment.

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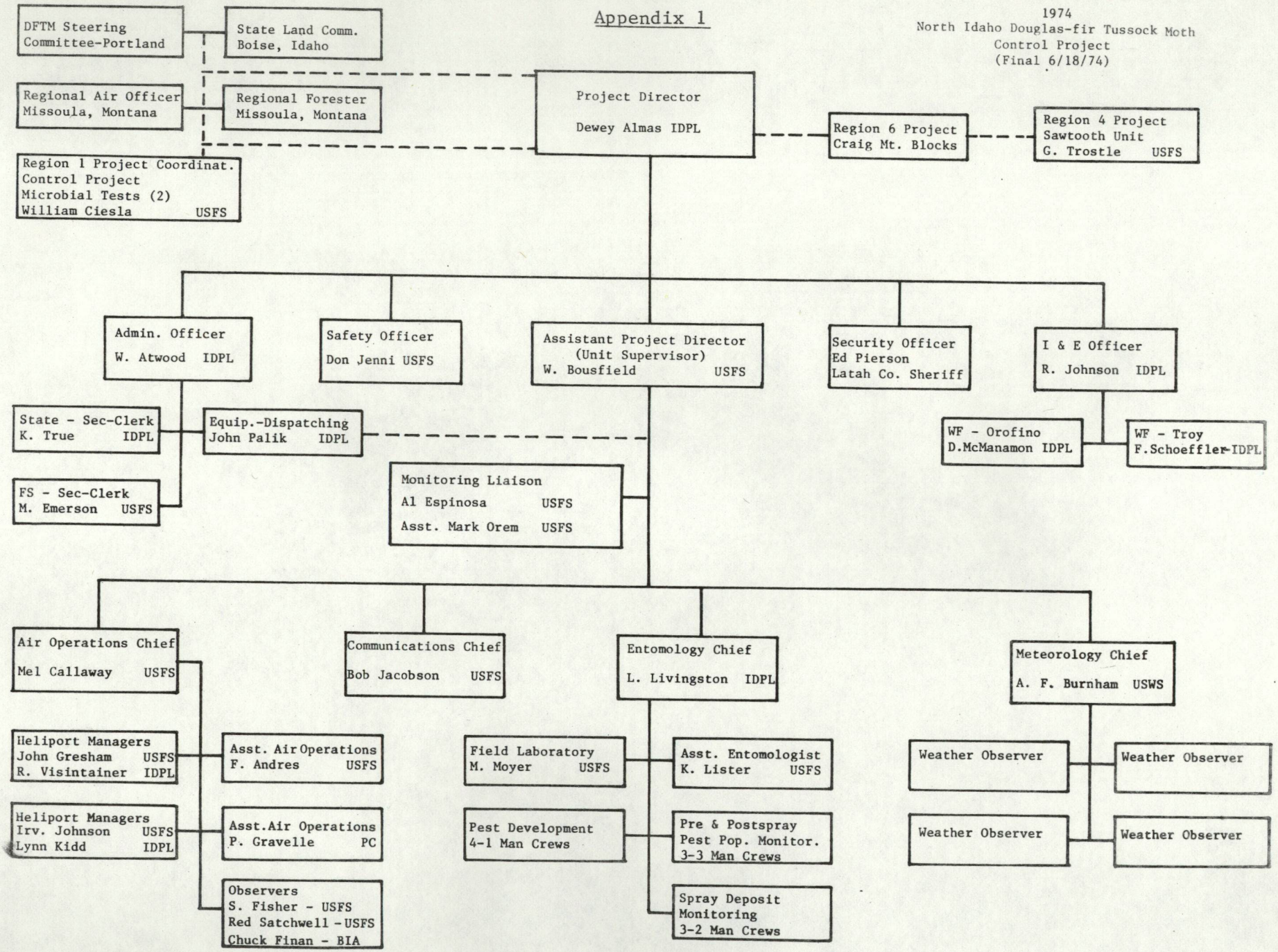
APPENDIX ITEMS

Appendix 1

1974
North Idaho Douglas-fir Tussock Moth
Control Project
(Final 6/18/74)



Appendix 2

IDAHO
DEPARTMENT OF PUBLIC LANDS

GORDON C. TROMBLEY
COMMISSIONER

ADDRESS REPLY TO:

DEPARTMENT OF PUBLIC LANDS
COEUR D' ALENE OFFICE
P.O. BOX 670, COEUR D' ALENE, IDAHO 83814

May 1, 1974

TO: Forest Land Owners

FROM: Idaho Department of Public Lands - Tussock Moth Control Project

SUBJECT: Community Information Meetings

A tussock moth infestation is building up in North Idaho. It now covers 257,000 forest acres. Medium to heavy damage on fir trees is expected over 104,000 of these acres. Extensive surveys were conducted and a detailed Environmental Impact Statement prepared by the U.S. Forest Service and cooperating agencies. This provided a basis for the decision by the U.S. Environmental Protection Agency to permit contingency use of DDT to protect our forests. A control project is now under way with spraying to begin in early June. Approximately 58,000 acres will be sprayed with 3/4 lbs. of DDT per acre. 46,000 acres of infestation on National Forest lands will be used for field testing of promising natural control agents and check plots or excluded as sensitive areas. Actual aerial application of the natural agents is planned for 27,000 acres. Only those areas where serious damage is expected will be sprayed. Extreme care will be exercised to avoid dairies, apiaries, major streams and other sensitive areas. The private landowner share of project costs has been paid by deducting 5% of the money withheld for disposal of logging slash on private land.

In order that landowners can be informed of control plans, a series of public meetings will be held. We are inviting you to attend if you are interested in the program. Please check the enclosed schedule for date, time and place of the meeting in your area.

Project personnel will be present to answer your questions and explain the project. Maps will be available showing the areas to be sprayed. We invite you to inspect them to determine if your land is included in the treatment area. If it is not and you feel that you have tussock moth that should be sprayed, please consult with a representative of the Idaho Department of Public Lands at the meeting. Arrangements will be made to have your forested land inspected for tussock moth. If tussock moth is present and it meets the population level criteria for spraying as set forth in the Environmental Impact Statement, the area may be added to the spray project. Conversely, if your land is included in the spray zone and you feel it is a sensitive area that should not be sprayed, consideration will be given to your desires. However, there may be areas which cannot be excluded without difficult and costly spray block adjustments. Reinfestation of adjacent forest properties can also result from excluded areas. In this situation the declaration of a zone of infestation (Idaho Code, Section 38-602) provides authority for the eradication and destruction of the forest pest in question on all property.

Maps will also be posted and made available for review by the public at the locations listed on the attached sheet.

There may be some pesticide residues developed in livestock which are grazed on forage directly in the DDT sprayed unit. Studies have shown no effects to the animals. The residue counts have generally returned to prespray levels in 4 to 6 months. Precautions to be taken by livestock owners will be discussed at the meetings.

If you have questions, please feel free to phone or come in and discuss your concerns with us. The North Idaho Douglas-fir Tussock Moth Control Project Headquarters will be at the following locations at the designated dates.

Idaho Department of Public Lands Coeur d'Alene Field Headquarters 701 River Avenue, Coeur d'Alene 667-7989	Present to May 19, 1974
Palouse Ranger Station Potlatch, Idaho 875-3291	May 20 to May 31, 1974
Potlatch High School Potlatch, Idaho 875-3291 or 875-3391	June 1 to End of Project

Thank you for your cooperation.

Sincerely yours,

GORDON C. TROMBLEY
State Land Commissioner

By /s/ Dewey Almas
Project Director

DA:drj
Enclosure

TENTATIVE PUBLIC MEETING SCHEDULE FOR 1974 DOUGLAS-FIR TUSSOCK MOTH CONTROL PROJECT

Date	Place	Time
To be announced	Coeur d'Alene *	7:30 p.m.
May 3	St. Maries, Washington Water Power	7:30 p.m.
May 6	Potlatch, Odd Fellows Hall	7:30 p.m.
May 10	Orofino *	7:30 p.m.
May 14	Plummer, Plummer Community Center	7:30 p.m.
May 17	Moscow *	7:30 p.m.
May 21	Grangeville *	7:30 p.m.
May 24	Troy *	7:30 p.m.
May 28	Lewiston *	7:30 p.m.

* Exact location or time will be advertised in local papers, or contact State, U. S. Forest Service or County Extension Offices.

MAP LOCATIONS FOR 1974 DOUGLAS-FIR TUSSOCK MOTH CONTROL PROJECT

In Coeur d'Alene

Coeur d'Alene Field Headquarters
Idaho Department of Public Lands
701 River Avenue, Coeur d'Alene

Panhandle National Forest Supervisor's Office, U. S. Forest Service
218 N. 23rd Street, Coeur d'Alene

Kootenai County Agricultural Extension Agent & Extension Forester
Kootenai County Courthouse
501 Government Way, Coeur d'Alene

In St. Maries

St. Joe Area Supervisor's Office
Idaho Department of Public Lands
1806 Main Avenue, St. Maries

St. Maries Supervisor's Office
U. S. Forest Service
Federal Building, St. Maries

Benewah County Agricultural Extension Agent
Federal Building, St. Maries

Clarkia Ranger Station
Clarkia

In Potlatch

Palouse Ranger Station
Potlatch

In Troy

Troy Woodland Forester's Office
Idaho Department of Public Lands

In Moscow

Latah County Agricultural Extension Agent
County Courthouse, Moscow

John Galea
Forestry Sciences Laboratory
1221 South Main, Moscow

Vern Burlison
Extension Forester
College of Forestry
University of Idaho

In Orofino

Clearwater National Forest Supervisor's Office, U. S. Forest Service
Ahsahka Road, Orofino

Clearwater Area Supervisor's Office
Idaho Department of Public Lands
Adjacent to National Guard Armory on Highway 12

Clearwater County Agricultural Extension Agent
Federal Building, Orofino

In Kendrick

Kendrick Forest Protective District Office
Idaho Department of Public Lands
R. R. Avenue at 9th Street, Kendrick

In Craigmont

Craig Mountain Forest Protective District Office
010 East Lorahama, Craigmont

In Lewiston

Nez Perce County Agricultural Extension Agent
1214 Main Street, Lewiston

Potlatch Corporation
East Lewiston

In Nezperce

Lewis County Agricultural Extension Agent
Lewis County Courthouse, Nezperce

Tentative for Worley, Plummer, Tensed

A Public Place

In Grangeville

Nezperce National Forest Supervisor's Office
U. S. Forest Service
319 East Main, Grangeville

Idaho County Agricultural Extension Agent
Idaho County Courthouse, Grangeville

Clearwater District Ranger's Office
319 East Main, Grangeville

NORTHERN IDAHO DOUGLAS-FIR TUSSOCK MOTH CONTROL PROJECT

THE INSECT: The Douglas-fir tussock moth is a defoliator of true firs and Douglas-fir. Tussock moth outbreaks average about 3 years but may persist as long as 8 years.

The female tussock moth is wingless. After mating in September, she lays her eggs on the cocoon from which she emerged. Her eggs are bound together in a frothy substance, with hairs from her body forming an egg mass of 130 to 200 eggs. After overwintering in the egg stage, the young caterpillars begin hatching in late May. Caterpillars start feeding immediately and continue until August. They are light and hairy and may be spread long distances by the wind.

CURRENT OUTBREAK: Defoliation by the tussock moth not only retards tree growth but kills trees. Complete tree defoliation may occur in a single season. Weakened trees often succumb to attacks by bark beetles.

EXTENT OF OUTBREAK: 104,000 acres of northern Idaho forests are anticipated to be damaged during June and July of 1974. A critical 58,000 acres will be sprayed with DDT. The criteria necessary to qualify the area as needing control is a concentration of approximately 20 tussock moth caterpillars per 1,000 square inches of tree foliage. If other areas meet control criteria, they may be included in the spray project.

DAMAGE APPRAISAL: Approximately 85 million board feet of timber could be lost and an additional 13 million board feet of potential growth will never be realized without DDT treatment. A net loss of $3,109,000 in forest values will occur in 1974 if the tussock moth is not controlled. The tussock moth defoliation will also create fire hazards, make trees vulnerable to bark beetles, result in loss of young growth, and create poor appearance.

CONTROL OF SPRAY: A 200-foot unsprayed buffer strip will be left around sensitive areas. Landowners' wishes about spraying will be considered. Only helicopters will be used to spray the DDT because of their maneuverability and spraying accuracy. Observation helicopters will monitor spraying helicopters.

BIOLOGICAL EVALUATION: Spraying will start after 70 percent of the tussock moth egg masses begin to hatch and have 3 days to develop. Biological evaluation data, collected during the project, should explain how many tussock moths were killed, how much foliage was saved, and how much growth loss prevented in the northern Idaho control project.

ALTERNATIVE CONTROL METHODS: Two microbial control agents for tussock moths will be tested on 27,000 acres in 1974 in the hope that they will prove effective in the control of the insect. As of now, however, DDT is the only effective means of control.

Prepared and published by the Idaho Department of Public Lands.
For additional information, write or telephone:
Idaho Department of Public Lands, P.O. Box 670, Coeur d'Alene, Idaho 83814
Telephone 667-7989

Appendix 3

1974 North Idaho Cooperative Douglas-fir
Tussock Moth Control Project

Community Meeting Outline

I. Welcome and Introductions (WF)

A. U. S. Forest Service personnel

B. State of Idaho personnel

C. Others

II. Circulate Attendance Listing

III. Introduction of Subject (I & E Officer)

IV. Tussock Moth Biology (Project Entomologist)

A. Slides and/or movie

B. Life cycle

C. Hosts and feeding pattern

D. Duration of epidemics

E. Natural control Factors

1. Starvation

2. Virus and Bacillus thuringiensis

3. Microbial tests

F. Area infested

G. Fall egg mass survey

H. Acres affected

1. 104,000 meet spray criteria

2. 58,000 is net spray block

3. 154,000 are light or DFTM present

V. Project Plan (Project Director)

A. Expected impact

1. 85 million board feet - mortality of 1974

2. 13 million board feet - growth loss of 1974

3. $3,109,000 net loss

B. Organization - cooperative nature

1. Spray date

2. Aircraft

C. Control of spray

1. Aerial photos carried by helicopter pilots

2. Sensitive areas marked

3. Observation aircraft

D. Sensitive areas

1. Beehives, pastures, crops, streams, etc.

2. Livestock - considerations in marketing for slaughter

E. Landowner interests

1. Financing - cost to landowners

a. State Pest Control Fund

b. U. S. Forest Service share

2. Minimum size of spray unit

3. Spray criteria

F. Monitoring of pesticide residues

1. Woody Benson - Idaho Dept. of Environmental & Community Services; and Al Espinosa - Project Liaison

2. Forage, litter, shrubs, water

VI. Meeting Recap (I & E Officer)

A. Summary of main points

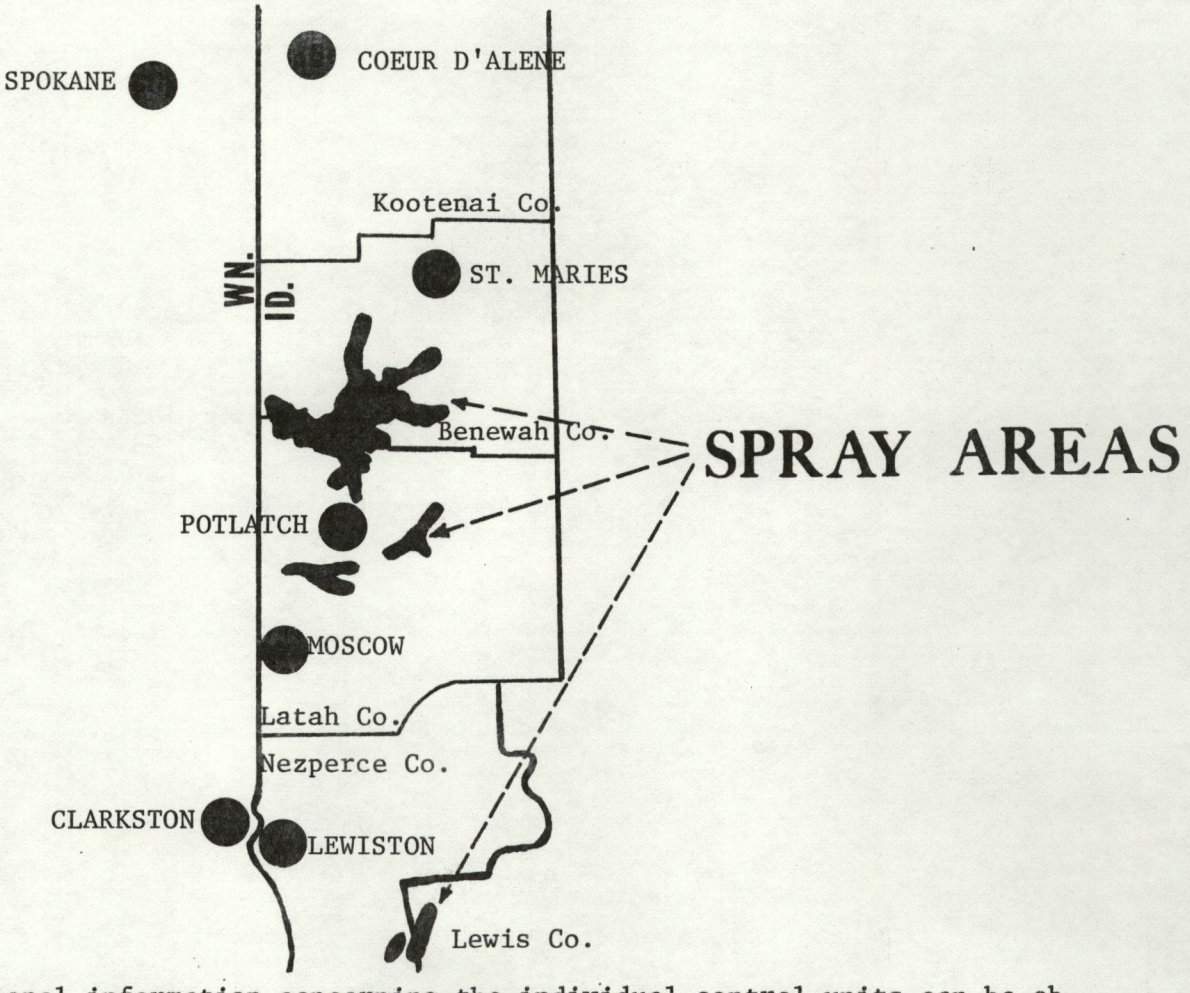
B. Get names and comments, locations of sensitive areas, etc.

Appendix 4

TUSSOCK MOTH CONTROL PROJECT

PUBLIC NOTICE

Aerial application of DDT to control the Douglas-fir Tussock moth infestation is planned for two control units located in Benewah-Latah and Lewis-Nez Perce Counties of Idaho. It is estimated that spraying of the insecticide will begin on or about June 15, 1974, and be completed by July 25, 1974.



Additional information concerning the individual control units can be obtained by writing or calling the St. Joe Project Director's office.

ST. JOE CONTROL UNIT — Dewey Almas, Project Director, State of Idaho-U. S. Forest Service Cooperative Tussock Moth Project, c/o Potlatch High School, Potlatch, Idaho 83855 Telephone: 208/875-3291

POMEROY UNIT — Dennis Martin, Supervisor, U. S. Forest Service Pomeroy Tussock Moth Project, General Delivery, Clarkston, WA 99403 Telephone: 509/758-3381

GORDON C. TROMBLEY
IDAHO STATE LAND COMMISSIONER

Appendix 5

TUSSOCK MOTH DEVELOPMENT AND TIMING OF SPRAY APPLICATION

Spray Block No.	DATE				
	First Egg Hatch	70% Egg Mass Hatch	Date Released	Begin Spraying	Complete Spraying
32	6/14	6/15	6/19	6/19	6/19
33	6/13	6/16	6/20	6/20	6/20
16	6/12	6/16	6/20	6/21	6/21
9	6/15	6/16	6/20	6/23	6/24
5	6/13	6/16	6/20	6/21	6/22
15	6/15	6/17	6/21	6/25	6/27
14	6/17	6/17	6/21	6/24	6/25
2	6/14	6/17	6/21	6/28	6/30
24	6/17	6/17	6/21	7/3	7/3
10	6/15	6/18	6/22	6/24	6/24
8	6/15	6/18	6/22	6/23	6/23
7	6/15	6/18	6/27	6/22	6/22
13	6/18	6/18	6/22	6/25	6/25
12	6/13	6/18	6/22	6/25	6/25
20	6/16	6/18	6/22	6/27	6/27
23	6/16	6/18	6/22	7/3	7/5
30	6/17	6/18	6/22	7/7	7/7
31	6/13	6/19	6/23	7/7	7/7
29	6/17	6/19	6/23	7/7	7/7
34	6/13	6/19	6/23	Sevin Test	
35	6/15	6/19	6/23	7/7	7/8
17	6/17	6/19	6/23	7/2	7/2
3	6/14	6/19	6/23	6/28	6/29
4	6/17	6/19	6/20	6/30	6/30
26	6/17	6/19	6/23	7/3	7/6
21	6/16	6/19	6/23	7/3	7/3
6	6/15	6/20	6/24	6/30	7/6
28	6/16	6/20	6/24	7/6	7/6
19	6/18	6/20	6/24	6/30	7/6
18	6/17	6/20	6/24	7/2	7/2
27	6/19	6/21	6/25	7/4	7/6
1	6/17	6/21	6/25	Deleted & portions added to 27 & 28	
25	6/16	6/21	6/25	7/6	7/6

Appendix 6

SPRAY BLOCK ACREAGE ADJUSTMENTS AFTER
JUNE 1974

Spray Block Number	Estimated Gross Initial Acreage	Less Estimated Buffered * Areas	Estimated Net Initial Acreage	Estimated Acreage Dropped -- Low Populations	Estimated Acreage Added -- Aerial Defoliation Surveys	Final Acreage Sprayed
1	1,575	---	1,575	700	-----	860
2	3,268	---	3,268	-----	-----	3,600
3	2,796	73	2,723	-----	-----	2,700
4	1,716	58	1,658	-----	-----	1,800
5	1,750	---	1,750	-----	-----	1,500
6	3,470	128	3,342	2,100	-----	1,200
7	1,507	80	1,427	-----	-----	1,600
8	2,615	121	2,494	-----	-----	2,200
9	2,215	14	2,201	-----	-----	2,550
10	2,538	397	2,141	-----	-----	1,750
12	2,540	198	2,342	-----	-----	1,700
13	1,766	82	1,684	-----	-----	1,300
14	1,836	79	1,757	-----	-----	1,600
15	2,794	192	2,602	-----	-----	2,600
16	3,868	48	3,820	-----	-----	3,700
17	2,318	340	1,978	-----	-----	2,100
18	2,348	73	2,275	-----	-----	2,100
19	4,957	308	4,649	-----	-----	4,200
20	2,835	288	2,547	-----	-----	2,100
21	1,168	34	1,134	-----	-----	1,200
23	2,365	70	2,295	-----	-----	1,850
24	1,879	---	1,879	-----	800	2,700
25	1,820	36	1,784	-----	-----	2,100
26	2,328	49	2,279	-----	2,000	4,250
27	4,048	---	4,048	-----	400	4,350
28	2,943	---	2,943	300	-----	2,640

(cont'd)

SPRAY BLOCK ACREAGE ADJUSTMENTS AFTER
JUNE 1974
(cont'd)

Spray Block Number	Estimated Gross Initial Acreage	Less Estimated Buffered * Areas	Estimated Net Initial Acreage	Estimated Acreage Dropped -- Low Populations	Estimated Acreage Added -- Aerial Defoliation Surveys	Final Acreage Sprayed
29	2,575	116	2,459	1,200	-----	1,250
30	1,852	---	1,852	-----	-----	1,550
31	3,197	237	2,960	-----	-----	2,900
32	2,295	34	2,261	-----	-----	1,975
33	4,057	---	4,057	-----	-----	3,350
34	3,100	34	3,066	1,200 acres deleted for Sevin test,		
35	2,102	63	2,039	remainder added to block 35.		3,979
Totals	84,441	3,152	81,289	5,500	3,200	75,254

* Buffered Areas consisted of: sensitive streams, pastures, fields, non-forested clearings, and other areas as requested by landowners.

Appendix 8

DATA FROM FALL 1974 EGG MASS SURVEY

Spray Block	Cluster Number	Cluster Location T	R	Sec	New Egg Masses Per 1000 in^2 Foliage
1	1	45N	4W	21	No data *
	2	45N	4W	28	0.00 *
2	15	43N	5W	11	No data **
	16	43N	5W	11	No data **
	17	43N	5W	10	0.00
	18	43N	5W	15	0.00
3	19	43N	5W	27	0.00
4	20	43N	5W	14	0.00
5	21	43N	4W	18	0.00
	22	43N	4W	19	0.00
6	12	43N	4W	17	No data *
	13	43N	4W	17	0.00 *
	14	43N	4W	5	No data *
7	24	43N	4W	28	0.00
8	25	42N	4W	4	0.00
	26	43N	4W	27	0.00
10	27	42N	4W	11	0.00
12	23	42N	3W	19	0.00
	28	42N	4W	26	0.00
	29	42N	3W	24	0.00
	30	42N	3W	19	0.00
13	31	42N	3W	29	0.00
14	47	42N	4W	1	0.00
	48	42N	3W	7	0.00
15	34	42N	3W	4	0.00
	40	42N	3W	5	0.00
16	10	43N	4W	22	0.00
	11	43N	4W	22	0.00
	60	43N	4W	24	0.00
18	37	43N	3W	21	0.00
19	32	43N	3W	35	0.00
	33	43N	3W	35	0.00
	35	43N	3W	15	0.00
	101	43N	3W	14	0.00
	102	43N	3W	14	0.00
	103	43N	3W	14	0.00
20	36	43N	3W	36	0.00
	38	43N	3W	24	0.00
	39	43N	2W	19	0.00

* Cluster located in portion of block deleted due to low populations. Not sprayed.

** Field crews unable to locate.

(Cont'd)

DATA FROM FALL 1974 EGG MASS SURVEY
(cont'd)

Spray Block	Cluster Number	Cluster Location T	R	Sec	New Egg Masses Per 1000 in^2 Foliage
21	9	43N	3W	4	0.00
23	7	44N	3W	28	0.00
	8	44N	3W	32	0.00
24	52	44N	3W	26	0.00
25	4	44N	4W	24	0.00
	5	44N	4W	24	0.00
26	6	44N	3W	18	0.00
27	3	45N	4W	34	0.00
28	57	46N	4W	26	0.00 *
	58	45N	4W	3	0.00
	59	45N	4W	2	0.00
29	41	40N	4W	6	0.00 *
	42	40N	4W	6	0.00
	43	40N	4W	7	0.00
30	44	40N	4W	19	0.00
	45	40N	4W	20	0.00
	46	40N	4W	20	0.00
31	49	40N	4W	8	0.00
	50	40N	4W	4	0.00
32	51	40N	4W	12	0.00
	53	40N	4W	1	0.00
33	54	40N	3W	8	0.00
	55	40N	3W	8	0.00
	56	40N	3W	5	0.00
101	Check - 72	43N	3W	17	0.00
	Check - 73	43N	3W	9	0.00
	Check - 74	43N	3W	9	0.00
	Check - 75	43N	3W	8	0.00
104	Check - 61	41N	2W	20	0.00
	Check - 62	41N	2W	17	0.00
	Check - 63	41N	2W	17	0.00
	Check - 64	41N	2W	17	0.00
	Check - 65	41N	2W	18	0.21 ***
	Check - 81	41N	2W	17	0.00
	Check - 82	41N	2W	18	0.00
	Check - 83	41N	2W	18	0.08 (**)
	Check - 84	41N	2W	18	0.00
	Check - 85	41N	2W	18	0.00

* Cluster located in portion of block deleted due to low populations. Not sprayed.

*** High risk of defoliation in 1975, based on egg-mass density greater than 0.14 egg mass/1000 in^2 foliage (Ludeman and Livingston, 1974).

(**) Some risk (low) of defoliation in 1975, based on egg-mass density greater than 0.00 but less than 0.1 egg mass/1000 in^2 foliage.

(Cont'd)

DATA FROM FALL 1974 EGG MASS SURVEY
(Cont'd)

Spray Block	Cluster Number	Cluster Location T	R	Sec.	New Egg Masses Per 1000 in^2 Foliage
105	Check - 66	43N	2W	20	0.00
	Check - 67	43N	2W	20	0.00
	Check - 70	43N	2W	20	0.00
	Check - 71	43N	2W	20	0.00
106	Check - 68	44N	2W	12	0.00
	Check - 69	44N	2W	11	0.54 ***
	Check - 80	44N	2W	11	0.00

*** High risk of defoliation in 1975, based on egg-mass density greater than 0.14 egg mass/1000 in^2 foliage (Ludeman and Livingston, 1974).

Appendix 9

MEMO TO THE STATE LAND BOARD

SUBJECT: Declaration of a zone of infestation of Douglas-fir Tussock Moth, superseding the Memo of February 19, 1974.

EXPLANATION: Pursuant to Section 38-602 ICA, it is requested that the Board approve a declaration of the existence of a zone of infestation of Douglas-fir Tussock Moth covering the described areas listed below.

The Douglas-fir Tussock Moth has been discovered in scattered areas of northern and southern Idaho. Scientific evidence indicates that the Douglas-fir Tussock Moth will most likely grow to epidemic levels in parts of the larger described area and for this reason the larger zone of infestation listed below is desirable.

Twp. 22N, Rge. 1,2&3W & 1,2&3E BM
Twp. 23N, Rge. 1,2&3W & 1,2&3E BM
Twp. 24N, Rge. 1&2W & 1,2&3E BM
Twp. 25N, Rge. 1&2W & 1,2&3E BM
Twp. 26N, Rge. 1&2W & 1,2&3E BM
Twp. 27N, Rge. 1&2W & 1,2&3E BM
Twp. 28N, Rge. 1,2&3W & 1,2&3E BM
Twp. 29N, Rge. 1,2,3&4W & 1,2&3E BM
Twp. 30N, Rge. 1,2,3&4W & 1,2,3,4,5,6,7,8&9E BM
Twp. 31N, Rge. 1,2,3,4&5W & 1,2,3,4,5,6,7,8&9E BM
Twp. 32N, Rge. 1,2,3,4&5W & 1,2,3,4,5,6,7&8E BM
Twp. 33N, Rge. 1,2,3,4&5W & 1,2&3E BM
Twp. 34N, Rge. 1,2,3,4&5W & 1,2&3E BM
Twp. 35N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 36N, Rge. 1,2,3,4,5&6W & 1,2,3,4,5,6&7E BM
Twp. 37N, Rge. 1,2,3,4,5&6W & 1,2,3,4,5,6&7E BM
Twp. 38N, Rge. 1,2,3,4,5&6W & 1,2,3,4,5,6&7E BM
Twp. 39N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 40N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 41N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 42N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 43N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 44N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 45N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 46N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 47N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 48N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 49N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 50N, Rge. 1,2,3,4,5&6W & 1,2&3E BM
Twp. 51N, Rge. 1,2,3,4,5&6W & 1,2&3E BM

South Idaho

Twp. 1N, Rge. 14,15,18,19&20E BM
Twp. 2N, Rge. 18&19E BM
Twp. 3N, Rge. 11&12E BM
Twp. 4N, Rge. 11&12E BM

Cooperative surveys, natural disease and pesticide test of control and control projects are planned for 1974. Declaration of a zone of infestation will facilitate these surveys, tests and possible control measures.

RECOMMENDATIONS: Approval of a zone of infestation.

Approved February 26, 1974.

Appendix 10

1974 NORTH IDAHO COOPERATIVE DOUGLAS-FIR
TUSSOCK MOTH CONTROL PROJECT

PERSONNEL ROSTER

Administrative Staff:

Dewey Almas, Project Director	Idaho Dept. of Lands
Wayne Bousfield, Asst. Project Director	U. S. Forest Service
*Wilbur Atwood, Admin. Officer	Idaho Dept. of Lands
Don Jenni, Safety Officer	U. S. Forest Service
Ed Pierson, Security Officer	Latah Co. Sheriff
Rex Johnson, Information & Education Officer	Idaho Dept. of Lands
**Don McManamon, Asst. I & E	Idaho Dept. of Lands
**Frank Schoeffler, Asst. I & E.	Idaho Dept. of Lands
Al Espinosa, Monitoring Liaison	U. S. Forest Service
Mark Orem, Asst. Monitoring Liaison	U. S. Forest Service
Kathleen True, Secretary-Clerk	Idaho Dept. of Lands
**Marjorie Emerson, Secretary-Clerk	U. S. Forest Service
John Palik, Equipment & Dispatcher	Idaho Dept. of Lands

Entomology:

Ladd Livingston, Entomology Chief	Idaho Dept. of Lands
*Ken Lister, Asst. Entomologist	U. S. Forest Service
*Maxine Moyer, Field Laboratory Technician	U. S. Forest Service
Debra Rose, Laboratory Technician	Idaho Dept. of Lands
*Doris Scoles, Laboratory Technician	Idaho Dept. of Lands
Frank SiJohn, Pest Development Crewman	Bureau of Indian Affairs
Louie Mahoney, Pest Development Crewman	Bureau of Indian Affairs
Steve Douglas, Pest Development Crewman	Idaho Dept. of Lands
Ron Hollybaugh, Pest Development Crewman	Idaho Dept. of Lands
David Beckman, Population Monitoring Foreman	Idaho Dept. of Lands
Laura Smith, Population Monitoring Crewleader	Idaho Dept. of Lands
Eric Anderson, Population Monitoring Crewleader	Idaho Dept. of Lands
Barbara Bircher, Population Monitoring Crewman	Idaho Dept. of Lands
Randy Lee, Population Monitoring Crewman	Idaho Dept. of Lands
Linda Smith, Population Monitoring Crewman	Idaho Dept. of Lands
Rick James, Population Monitoring Crewman	Idaho Dept. of Lands
*Warren Brown, Population Monitoring Crewman	Idaho Dept. of Lands
Gail Workman, Population Monitoring Crewman	Idaho Dept. of Lands
*Lyle Thompson, Population Monitoring Crewman	Idaho Dept. of Lands
Lisbeth Thompson, Population Monitoring Crewman	Idaho Dept. of Lands
Wayne Ludeman, Spray Deposit Foreman	Idaho Dept. of Lands
Bruce McCrory, Spray Deposit Crewman	Idaho Dept. of Lands
Jack Wilson, Spray Deposit Crewman	Idaho Dept. of Lands
Bob Desrochers, Spray Deposit Crewman	Idaho Dept. of Lands
Eugene Fink, Spray Deposit Crewman	Idaho Dept. of Lands
*Harold Preston, Spray Deposit Crewman	Idaho Dept. of Lands
*Mike Egland, Spray Deposit Crewman	Idaho Dept. of Lands
*Kurt Naccarato, Spray Deposit Crewman	Idaho Dept. of Lands

Communications:

Bob Jacobson, Communications Chief . . . . . U. S. Forest Service
**Ed Russell, Communications Chief . . . . . U. S. Forest Service

Meteorology:

A. F. Burnham, Meteorology Chief . . . . . U. S. Weather Service
**Dave Goens, Asst. Meteorology Chief. . . . . U. S. Weather Service
Don Aldrich, Weather Observer Foreman. . . . . Idaho Dept. of Lands
John Crowe, Weather Observer . . . . . Idaho Dept. of Lands
Ellis Emerson, Weather Observer. . . . . Idaho Dept. of Lands
James Lyon, Weather Observer . . . . . Idaho Dept. of Lands

Air Operations:

Mel Callaway, Air Operations Chief . . . . . U. S. Forest Service
Fritz Andres, Asst. Air Operations . . . . . U. S. Forest Service
Paul Gravelle, Asst. Air Operations. . . . . Potlatch Corporation
Sally Fisher, Aerial Observer. . . . . U. S. Forest Service
Red Satchwell, Aerial Observer . . . . . U. S. Forest Service
Chuck Finan, Aerial Observer . . . . . Bureau of Indian Affairs
John Gresham, Heliport Manager . . . . . Idaho Dept. of Lands
*Rick Visintainer, Heliport Manager . . . . . Idaho Dept. of Lands
*Ken Till, Heliport Manager . . . . . U. S. Forest Service
*Dave Cady, Heliport Manager. . . . . Idaho Dept. of Lands
Irv Johnson, Heliport Manager. . . . . U. S. Forest Service
Lynn Kidd, Heliport Manager. . . . . Idaho Dept. of Lands
B. Roberge, Heliport Relief. . . . . Idaho Dept. of Lands

Evergreen Helicopters:

Tim McDuffy, Administrative Management
John Longstreet, Pilot
**Hank DuVoll, Pilot
**Tom Schaub, Relief Pilot
**Bruce Finkey, Relief Pilot
Tom Pitzer, Mechanic
Clifford Childer, Truck Foreman
John Rhein, Driver-loader
John Paola, Driver-loader
Tina Shepherd, Security

Empire Lumber Company:

*Emory Hall, Observation Pilot
Craig Simpson, Observation Pilot

Skychoppers of Utah:

Mike Wilton, Observation Pilot
*Wayne Potts, Observation Pilot

Harbor Distributing:

**Ed Huntsman, Pesticide Formulation Contractor Rep.

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* Did not work full length of project.
** Served on project for periods when needed or assigned.